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WT 21-145

TEST OF THE SPACE-GENERAL
NIKE-IROQUOIS IN THE JPL
21-INCH HYPERSONIC
TUNNEL

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PLOTS

Plot No.	Run No.	Configuration		Test No.	ϕ (deg)	Mach No.	q (psia)
1	2	B1	F1	21-145	0	8.00	2.80
	8		F2				
	16		F3				
	21		F4				
	27		F5				
	35		F6				
2	3		F1		15		
	9		F2				
	17		F3				
	22		F4				
	28		F5				
3	10		F2		22.5		
4	4		F1		30.0		
5	11		F2				
	18		F3				
	23		F4				
	29		F5				
	37		F6				
5	24		F4		37.5		
5	31		F5		37.5		

PLOTS (Cont'd)

Plot No.	Run No.	Configuration		Test No.	ϕ (deg)	Mach No.	q (psia)
5	38	B1	F6	21-145	37.5	8.00	2.80
6	5		F1		45		
	12		F2				
	19		F3				
	25		F4				
	30		F5				
	39		F6				
7	6	F1			60		
	15		F2				
	20		F3				
	26		F4				
	32		F5				
	40		F6				
8	46	F1			0	6.5	3.6
	51		F4				
	57		F5				
	63		F6				
9	45	F1			15		
	52		F4				
	58		F5				
	64		F6				

PLOTS (Cont'd)

Plot No.	Run No.	Configuration		Test No.	ϕ (deg)	Mach No.	q (psia)
10	69	B1	F6	21-145	22.5	6.5	3.6
11	47		F1		30		
	53		F4				
	59		F5				
	65		F6				
12	48		F1		37.5		
	54		F4				
	60		F5				
	66		F6				
12	49		F1		45		
	55		F4				
	61		F5				
	67		F6				
14	50		F1		60		
	56		F4				
	62		F5				
	68		F6				
15	70		F1		0	5.0	3.1
	97		F2				
	105		F3				

PLOTS (Cont'd)

Plot No.	Run No.	Configuration		Test No.	ϕ (deg)	Mach No.	q (psia)
15	77	B1	F4	21-145	0	5.0	3.1
	84		F5				
	91		F6				
16	71		F1		15		
	98		F2				
	106		F3				
	78		F4				
	85		F5				
	92		F6				
17	76		F1		22.5		
	99		F2				
	107		F3				
	83		F4				
	90		F5				
	93		F6				
18	72		F1		30.0		
	100		F2				
	108		F3				
	79		F4				
	86		F5				
	94		F6				

PLOTS (Cont'd)

Plot No.	Run No.	Configuration		Test No.	ϕ (deg)	Mach No.	q (psia)
19	73	B1	F1	21-145	37.5	5.0	3.1
	101		F2				
	109		F3				
	80		F4				
	87		F5		↓		
20	74		F1		45		
	103		F2				
	110		F3				
	81		F4				
	88		F5				
	95		F6		↓		
21	75		F1		60		
	104		F2				
	111		F3				
	82		F4				
	89		F5				
	96		F6		↓		
22	112		F1		0		3.5
	113				15		
	114				22.5		

PLOTS (Cont'd)

Plot No.	Run No.	Configuration	Test No.	ϕ (deg)	Mach No.	q (psia)
22	115	B1 F1	21-145	30.0	5.0	3.5
	116			37.5		
	117			45.0		
	118			60.0		

I. INTRODUCTION

Wind-tunnel Test 21-145 was a test of the Space-General Corporation (El Monte) Nike-Iroquois model. The purpose of the test was to obtain aerodynamic characteristics and basic data in support of a theoretical investigation of the effects of interactions, between a body-shed vortex system and stabilizing surfaces, in producing induced vehicle rolling moments at higher Mach numbers. The approximate aerodynamic parameters for the test were Mach No. 5.0 to 8.0 and Reynolds No. /in. from 0.050×10^6 to 0.25×10^6 . The test variables and ranges were angle of attack from -4 to +16 deg and angle of roll from 0 to +60 deg.

The model configuration comprised a 29.4-in. -long centerbody with a 20-deg included-angle conical nose and six dissimilar afterbodies differing in the planform geometry of the attached stabilizing fins and, in one case, having a slight flare at the rear of the afterbody. Forces and moments were obtained for the complete configuration.

The test* was conducted at the Jet Propulsion Laboratory (JPL) from October 23 through 25, 1963, with the Space-General Corporation represented by Mr. J. P. Taylor.

II. MODEL DESCRIPTION

The model is shown in Fig. 1. A more detailed description of the model and components is contained in Ref. 1.

*Symbols used in this Report are defined in the Nomenclature.

III. WIND TUNNEL AND INSTRUMENTATION

Reference 2 describes the construction and operating conditions of the 21-in. hypersonic wind tunnel. The wind tunnel has a nominal test-section size of 21 in. square, a Mach range from 5 to 10, a flexible-plate nozzle, and operates with continuous flow. Table 1 presents representative values of the test-section flow parameters for the Mach numbers at which this test was conducted.

A six-component, internal, strain-gage balance was used to measure force-and-moment data.

IV. TEST PROCEDURE

Prior to actual test operations, measurements were made to determine the position of the model, the deflection constants, and the balance tares. During the test, data points were obtained at successive values of angle of attack. These data points were plotted vs load, and any data which appeared questionable were checked before the conclusion of the run. At least one data point was checked even if all data appeared correct.

V. DATA REDUCTION

The force-and-moment data were reduced to dimensionless coefficients in coordinates specified by the Space-General Corporation. The coefficients were obtained as follows:

$$\text{force coefficient} = \frac{\text{force}}{qA}$$

$$\text{moment coefficient} = \frac{\text{moment}}{qAd}$$

where

q = free-stream dynamic pressure (psia)

A = reference area = 1.327 (in.²)

d = reference length = 1.300 (in.)

and the point about which the moments were measured was 14.393 in. from the model base, on the model centerline. The chord-force coefficient was corrected to eliminate the base-drag increment due to the differential between base pressure and free-stream static pressure.

The coefficients were obtained on a digital computer by a standardized series of formulas as indicated in Ref. 3. The repeatability of the coefficient data is indicated in Table 2.

The coefficients are defined in the Nomenclature, and the coefficient sign conventions are shown in Fig. 2.

VI. RESULTS

The results of this test have been reduced to dimensionless coefficients and are presented in Plot Series 1a through 22f. No attempt was made in this Report to interpret the results.

NOMENCLATURE

Model

- A₁ afterbody section; straight cylindrical section, 1.300 in. diameter and 6.559 in. long
- B₁ vehicle body designation; composed of N₁ (nose), S₁ (spacer), C₁ (centerbody), and A₁ (afterbody)
- C₁ centerbody section; a straight cylindrical section, 1.300 in. diameter and 13.734 in. long; mounting pad for Space-General Corporation 0.75-in. Task Mark III; water-cooled balance system is an integral part of C₁ centerbody.
- F₁ fin designation; a 9.32%-thick, blunted wedge section; aspect ratio (on exposed area and exposed span of two panels) of 2.644; span of 3.136 in., root chord of 3.250 in., taper ratio of 0.460, leading-edge sweep of 48.7 deg, leading-edge diameter to base thickness of 16.5%
- F₂ fin designation; similar to F₁ fin, except leading-edge sweep angle is 38.0 deg.
- F₃ fin designation; similar to F₁ fin except root chord is 3.900 in.; tip chord is 1.794 in.; aspect ratio is 2.205.
- F₄ fin designation; similar to F₁ fin except span is increased to 3.786 in.; aspect ratio is 3.192.
- F₅ fin designation; similar to F₁ fin except span is reduced to 2.486 in.; aspect ratio is 2.099.
- F₆ fin designation; similar to F₁ fin except used with A₂ (flared) afterbody
- N₁ nose section; a 10-deg semivertex angle cone, blunted to a hemispherical tip, followed by a straight cylindrical section; diameter of hemispherical tip = 0.084 in.; over-all length = 6.304 in.; base diameter = 1.300 in.
- S₁ body spacer section; a straight cylindrical section 1.300 in. diameter and 2.600 in. long

NOMENCLATURE (Cont'd)

Data

CA	axial-force coefficient
CL	rolling-moment coefficient
CMCG	pitching-moment coefficient
CN	normal-force coefficient
CNCG	yawing-moment coefficient
CY	side-force coefficient
M ₀	free-stream Mach number
q	free-stream dynamic pressure (psia)
ALPHA	angle of attack (deg)
φ	angle of roll (deg)

REFERENCES

1. Space-General Corporation. Pretest Report for the Jet Propulsion Laboratory 21-Inch Hypersonic Wind Tunnel, J. P. Taylor. El Monte, California, S-GC, September 27, 1963. UNCLASSIFIED
2. Jet Propulsion Laboratory, California Institute of Technology. Wind-Tunnel Facilities at the Jet Propulsion Laboratory, Wind-Tunnel Staff. Pasadena, California, JPL, April 18, 1961. (Technical Release No. 34-257) UNCLASSIFIED
3. Jet Propulsion Laboratory, California Institute of Technology. Equations for Wind-Tunnel-Force Data Reduction. Pasadena, California, JPL, April 19, 1957. (Internal Memorandum SWT G-T 3) UNCLASSIFIED

Table 1. Average aerodynamic parameters

Parameter	Mach Number		
	8.0	6.5	5.0
Static pressure (psia)	0.01	0.12	0.17
Stagnation pressure (psia)	616.0	337.0	96.3
Dynamic pressure (psia)	2.8	3.6	3.1
Reynolds number (per in. $\times 10^{-6}$)	0.25	0.14	0.05

Table 2. Coefficient repeatability

Mach No.	Coefficient*					
	CN	CMCG	CY	CNCG	CA	CL
8.0	0.051	0.188	0.032	0.091	0.023	0.006
6.5	0.042	0.165	0.027	0.100	0.018	0.005
5.0	0.048	0.232	0.031	0.121	0.021	0.006

*Based upon the following reference area and length: $A = 1.327 \text{ in.}^2$, and $d = 1.30 \text{ in.}$

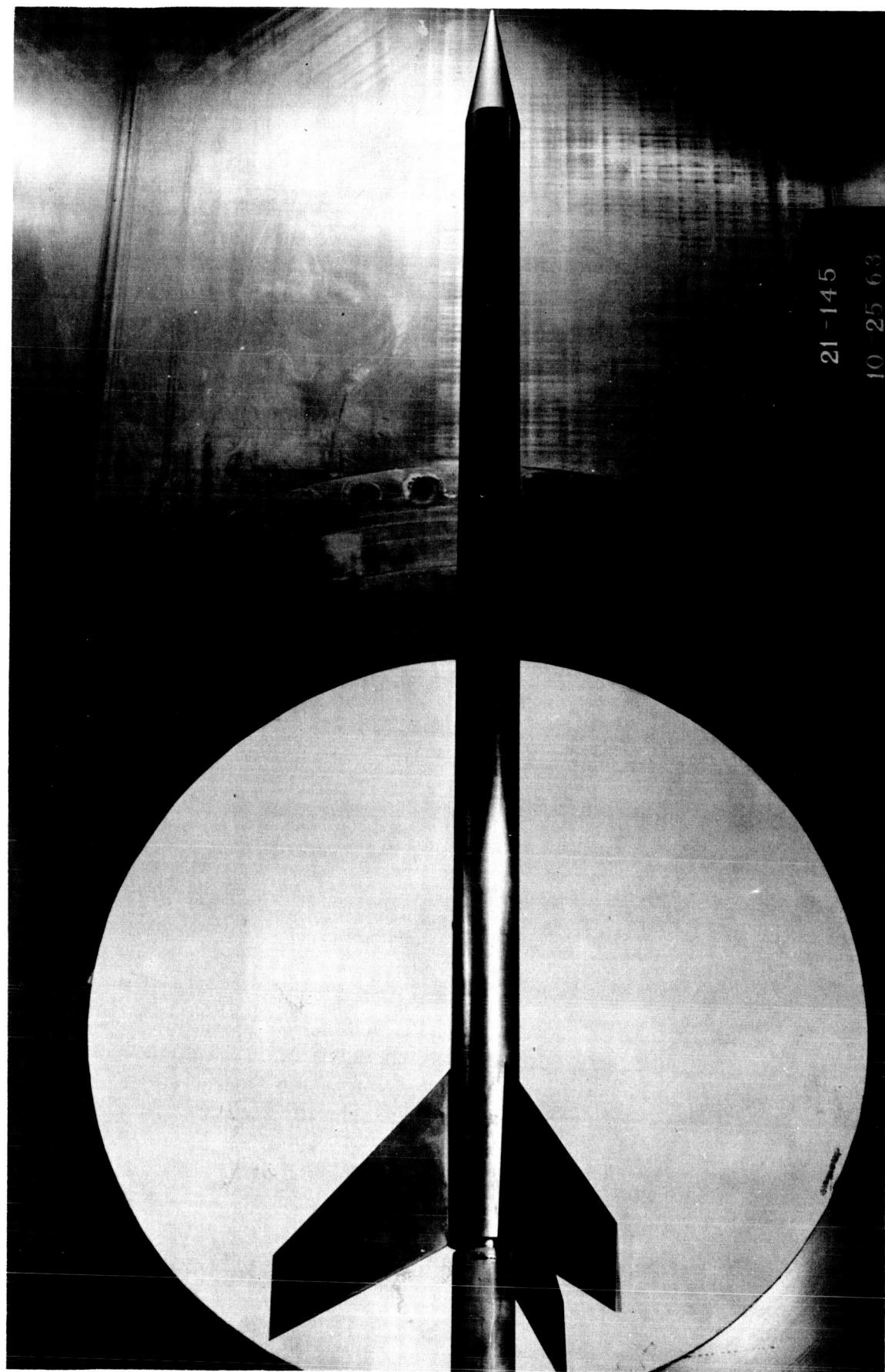
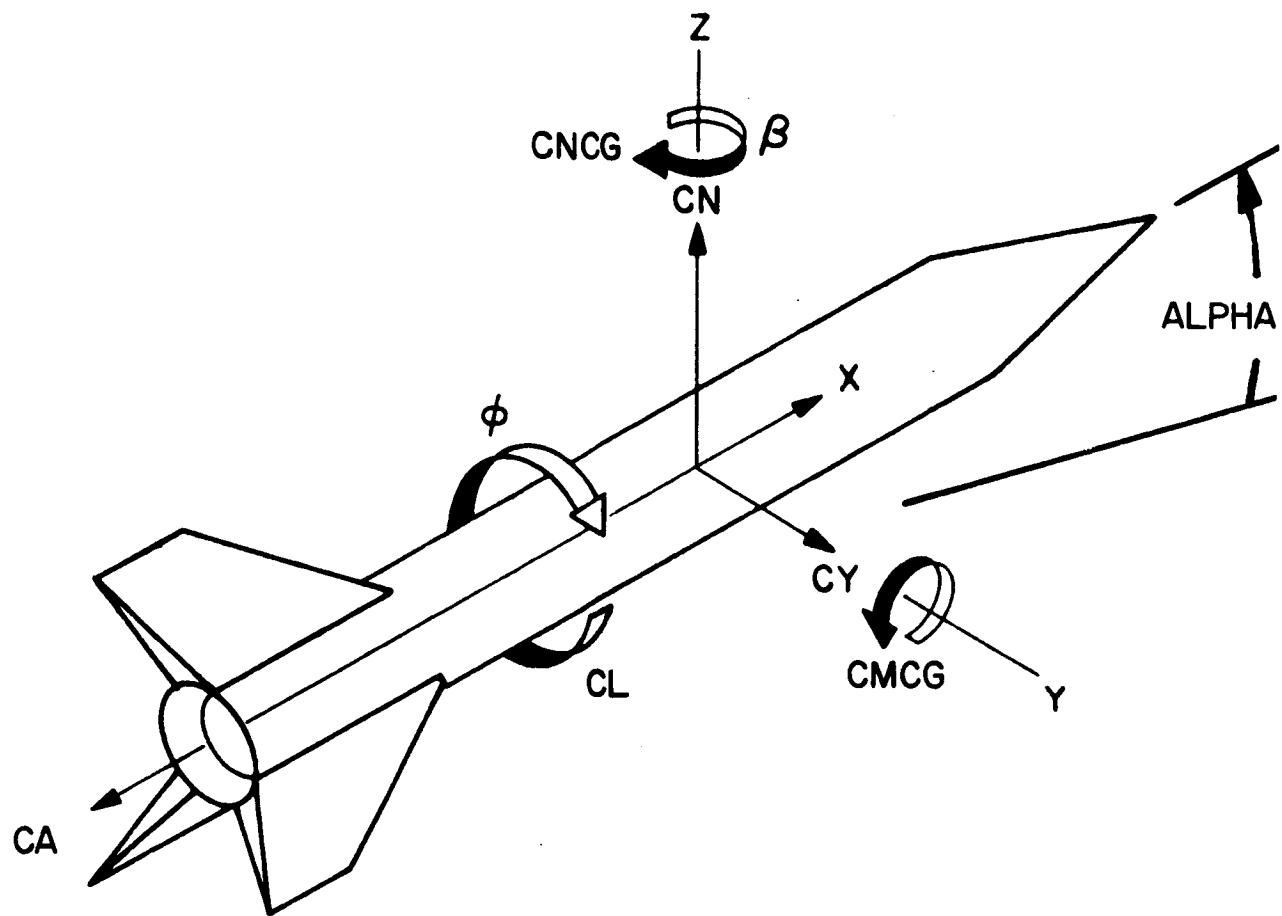


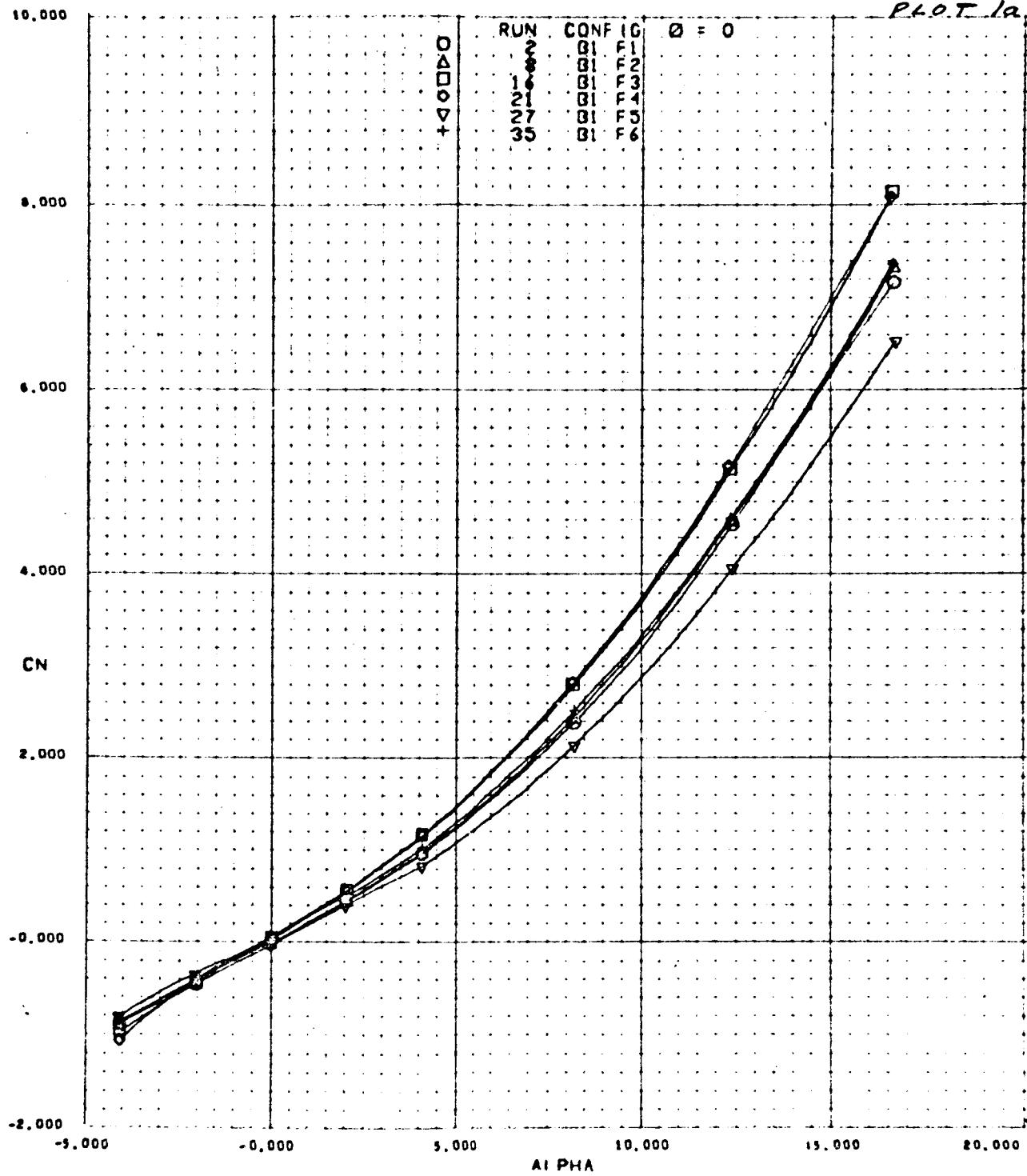
Fig. 1 Model Installation in the 21-in. H.W.T.

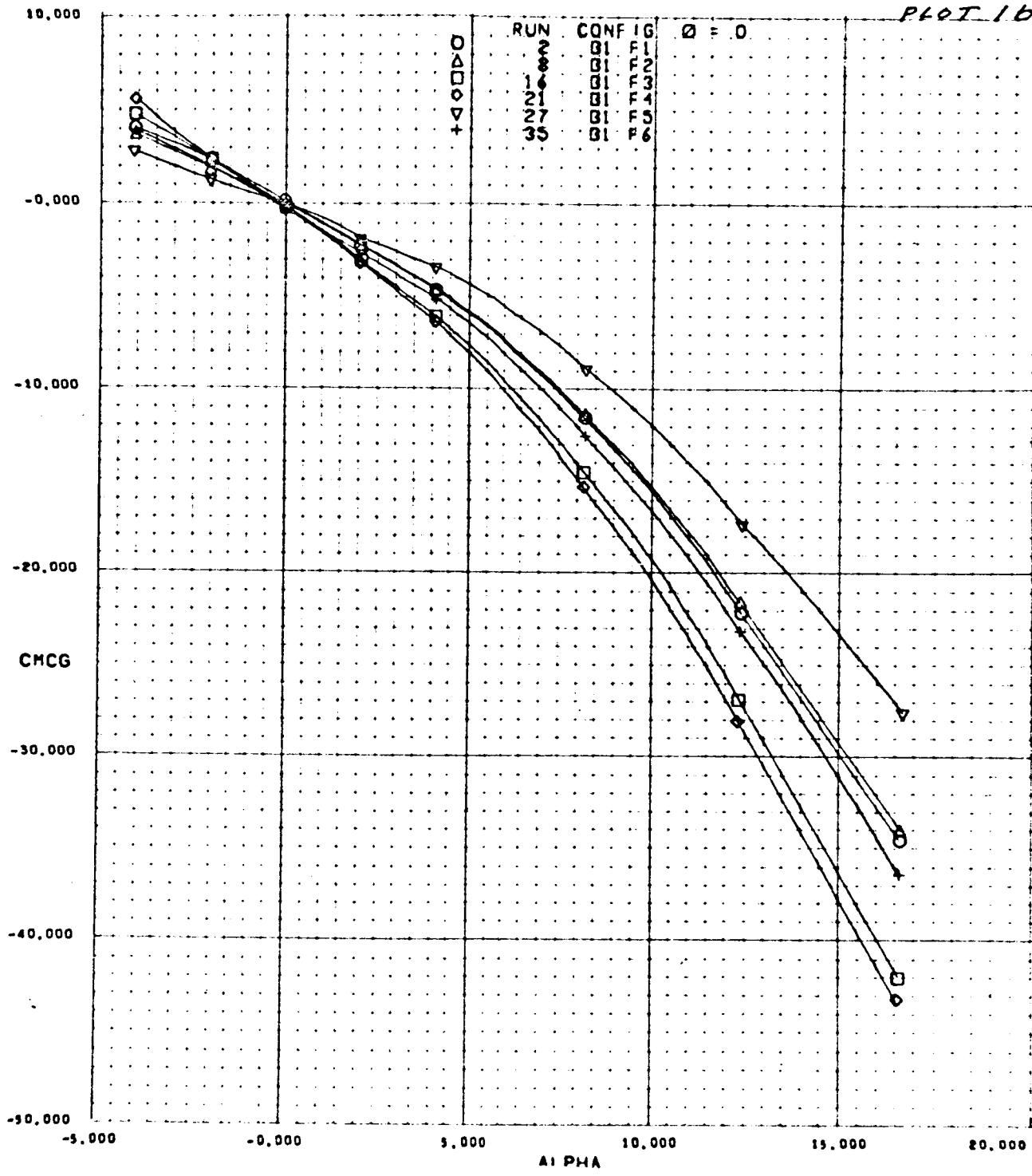


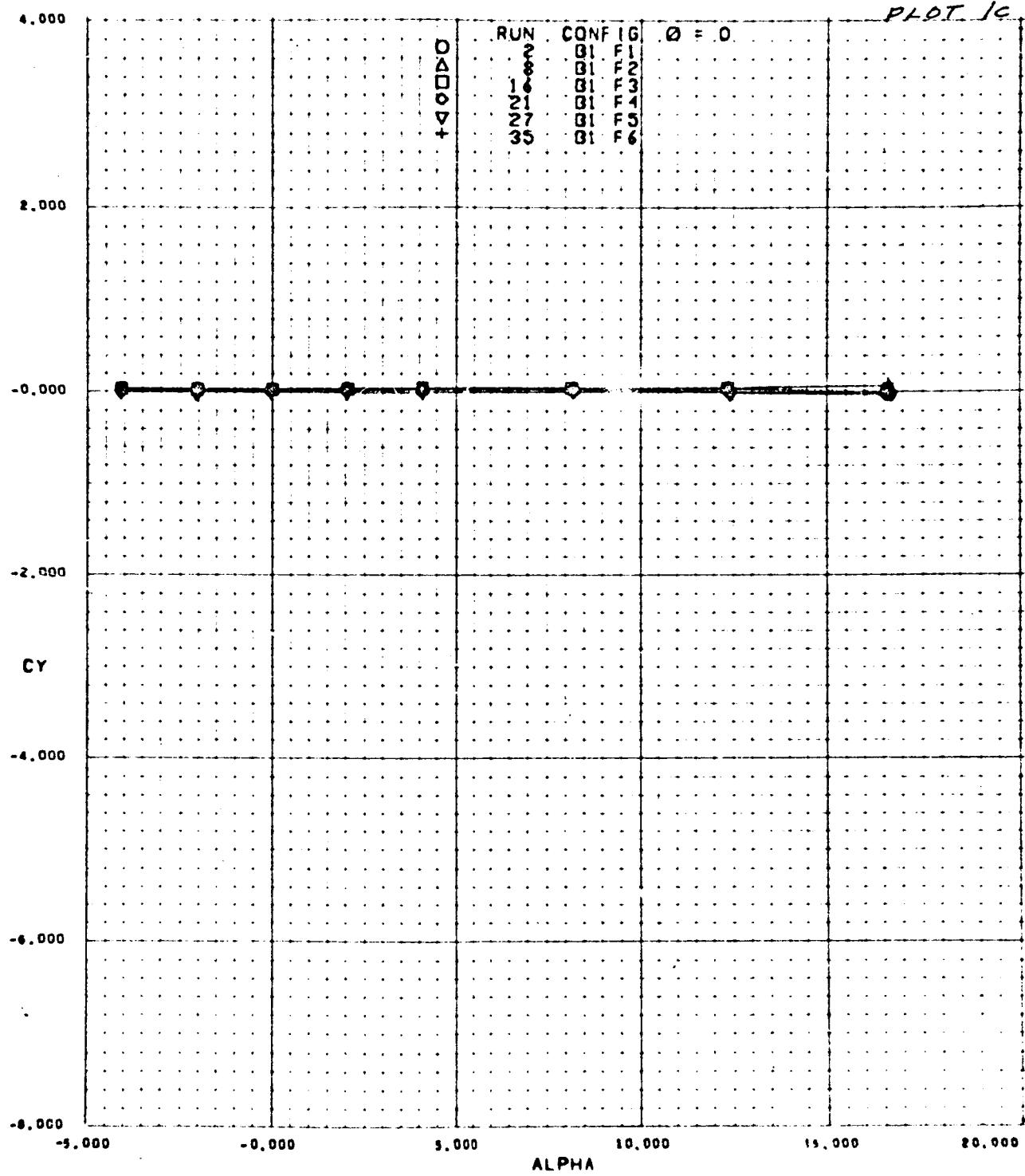
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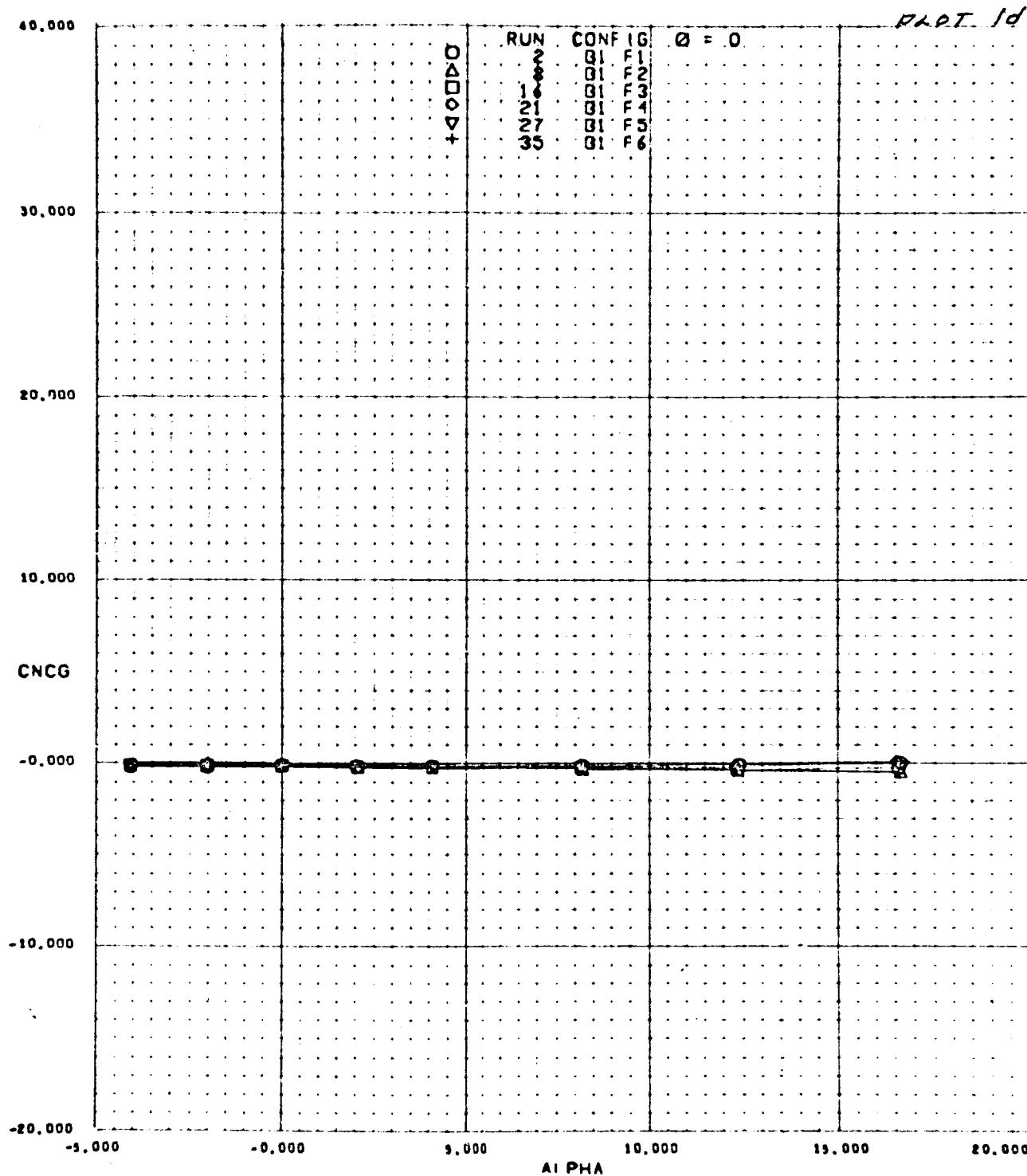
ARROWS INDICATE POSITIVE DIRECTIONS OF
ATTITUDE ANGLES, FORCES, AND MOMENTS

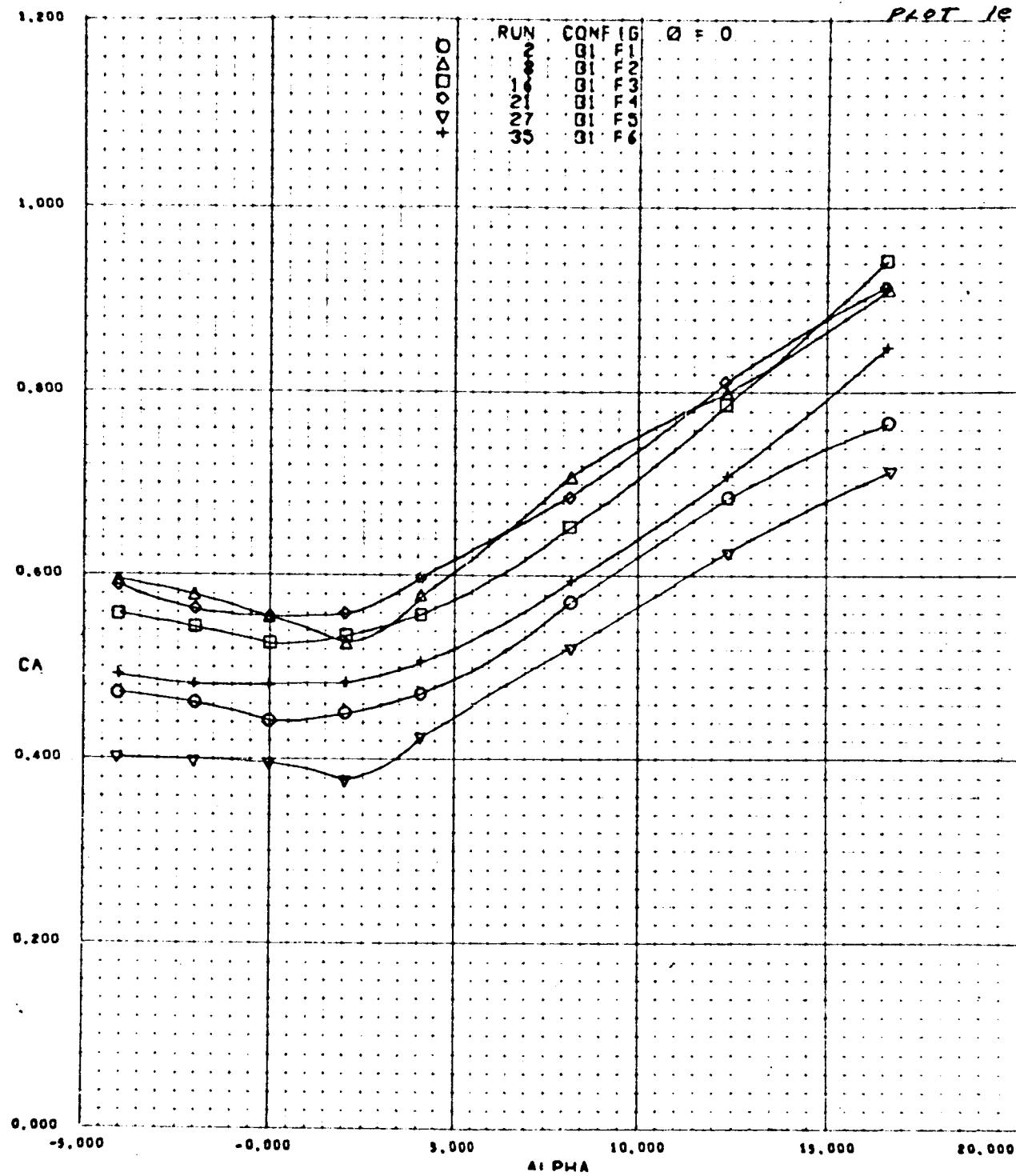
Fig. 2 Sign Conventions

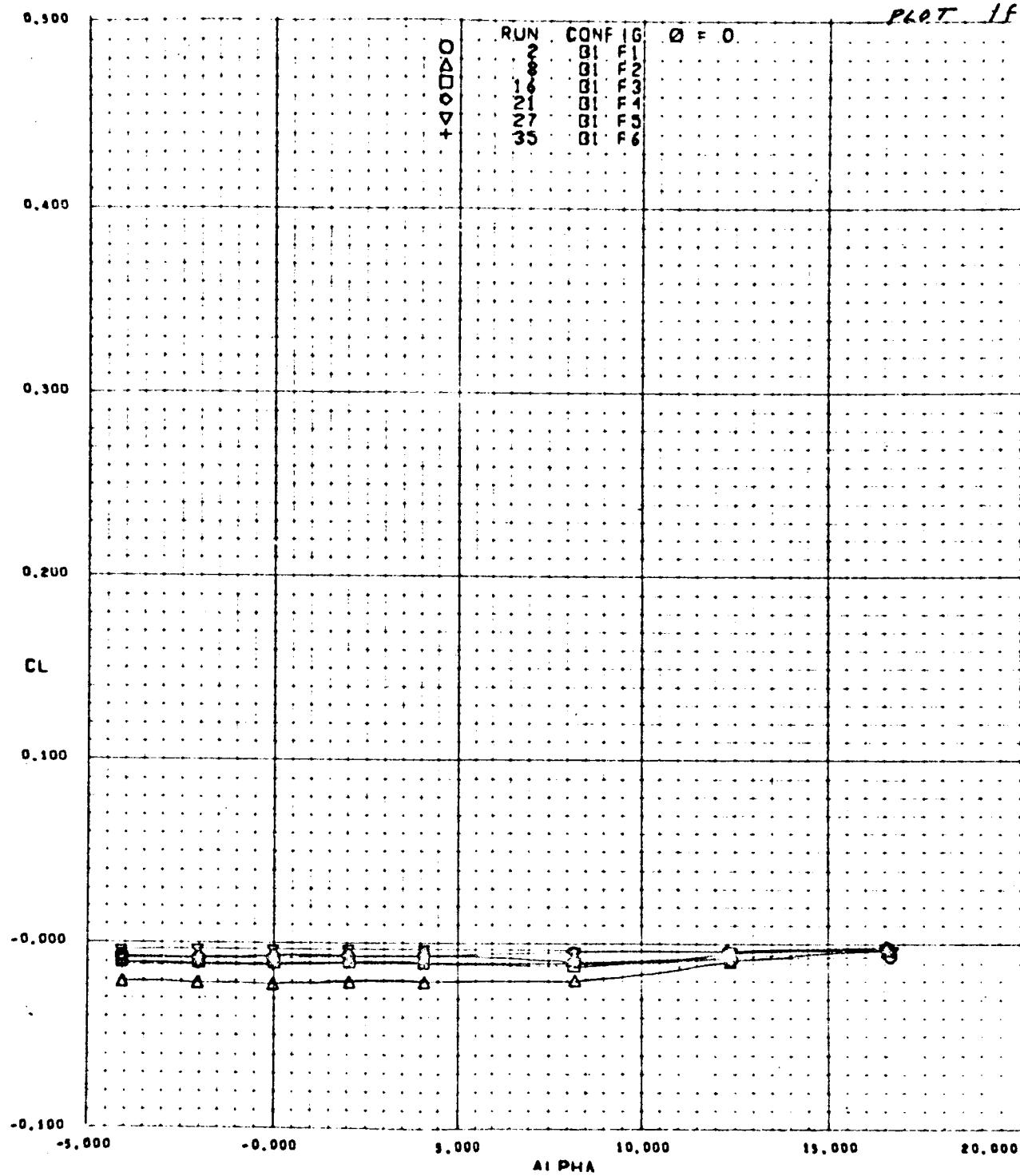


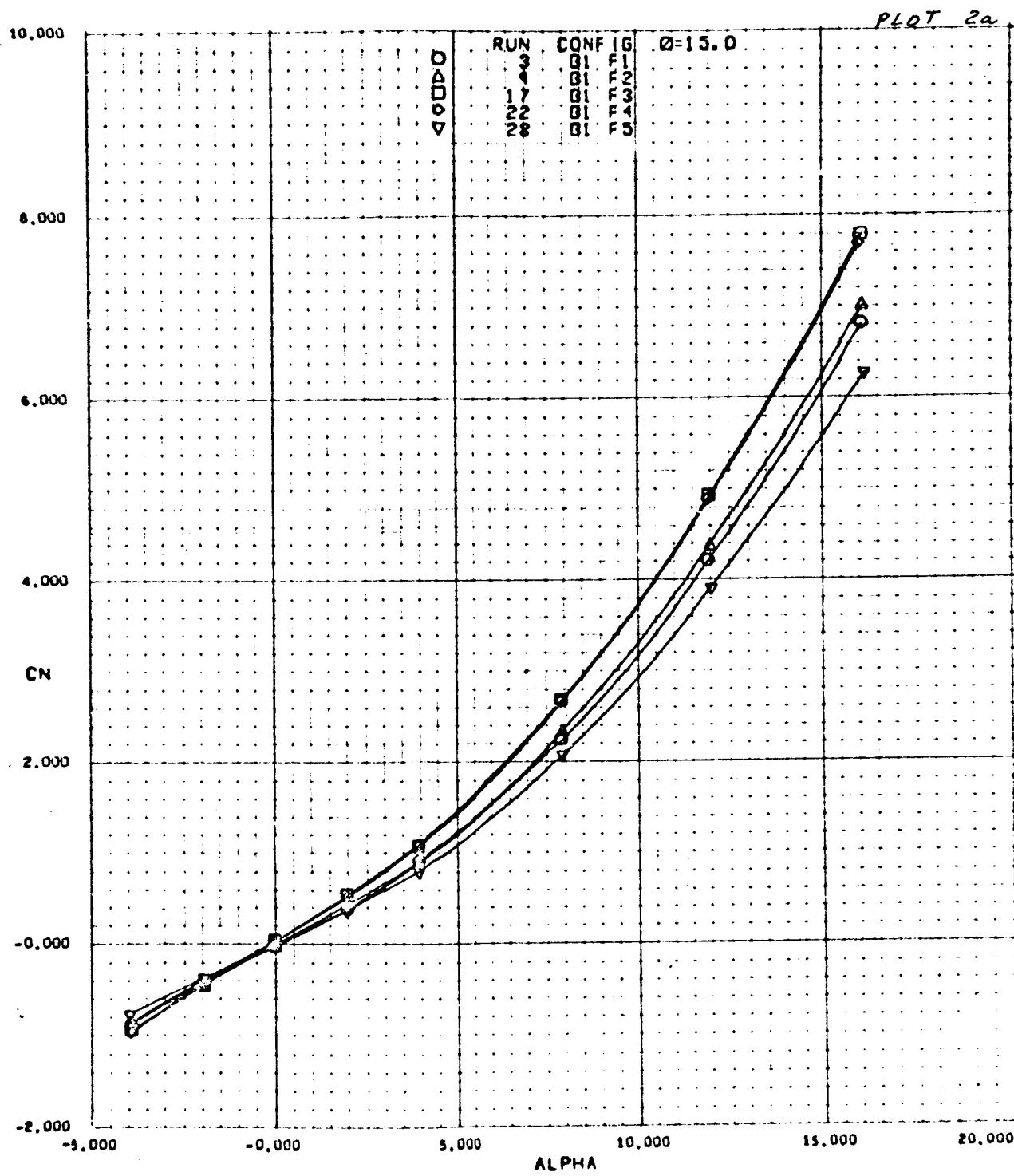


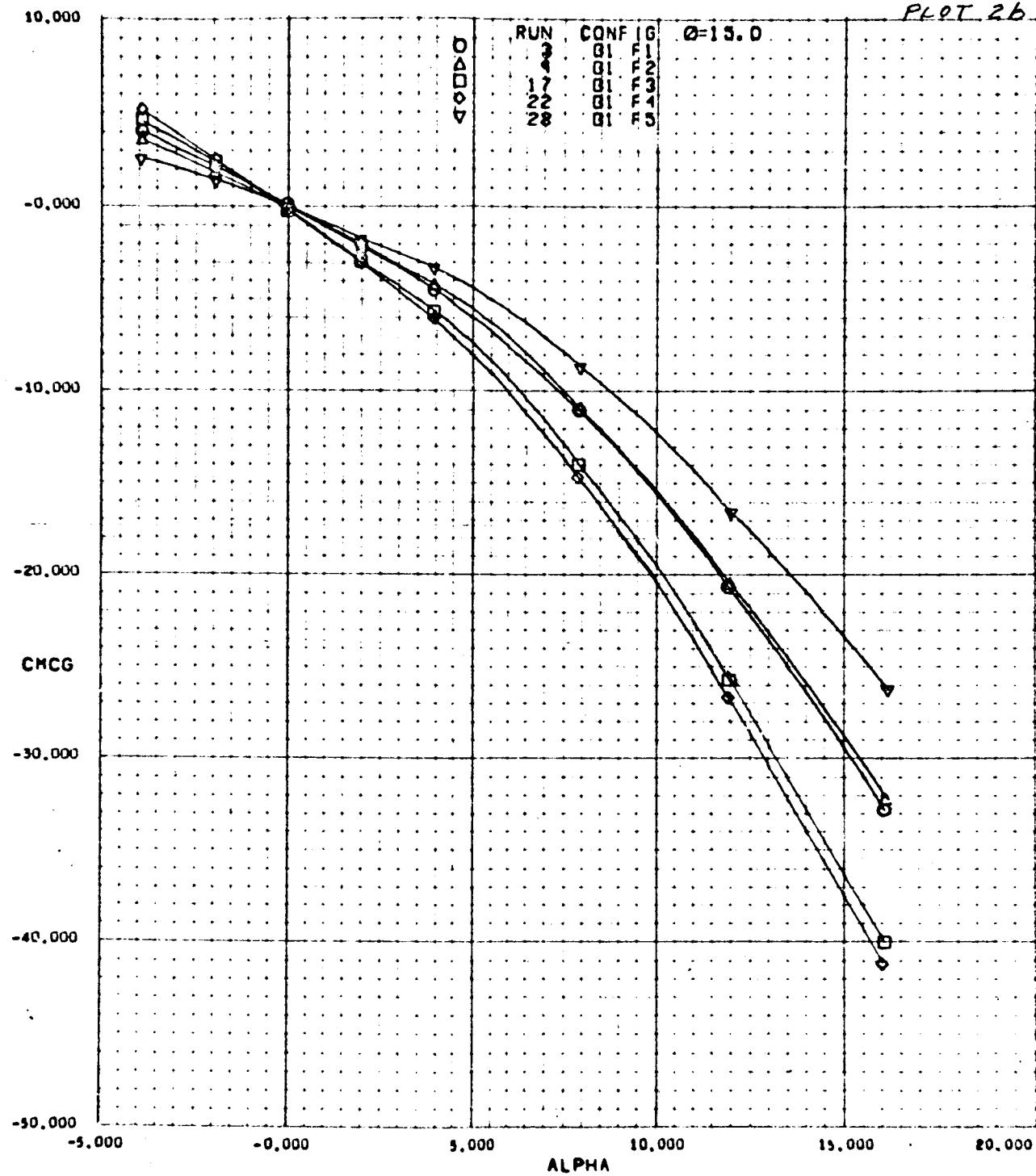


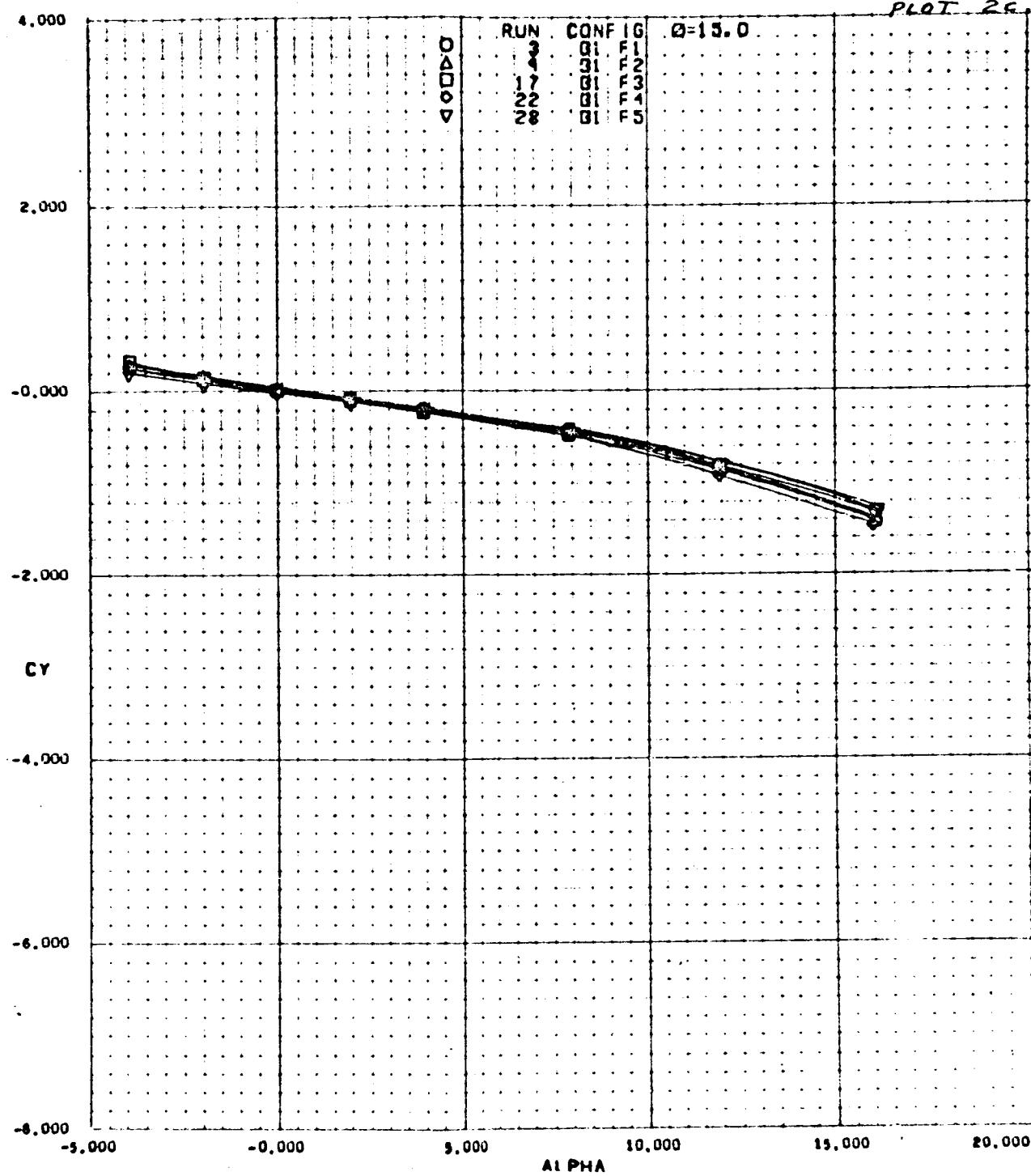


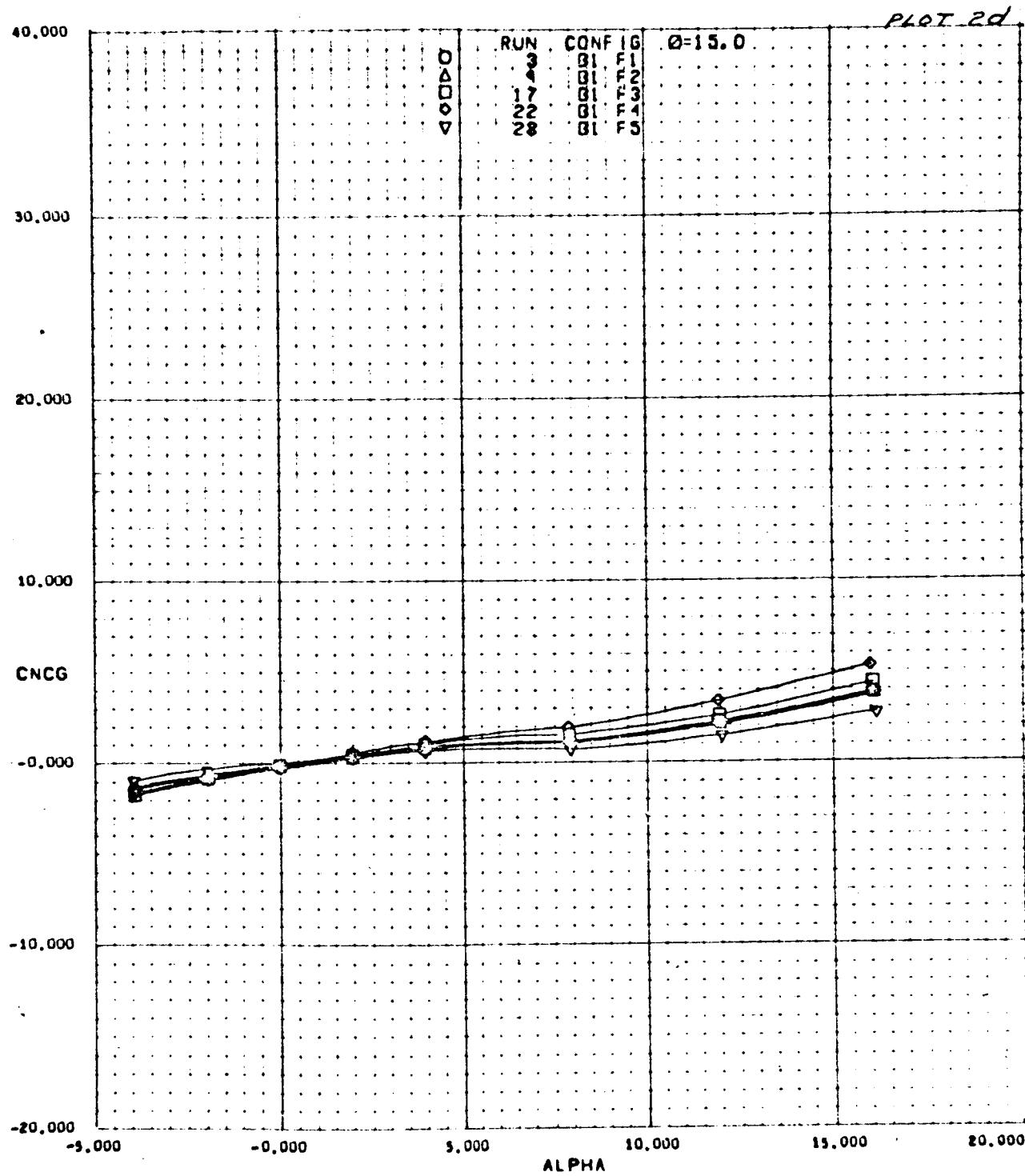


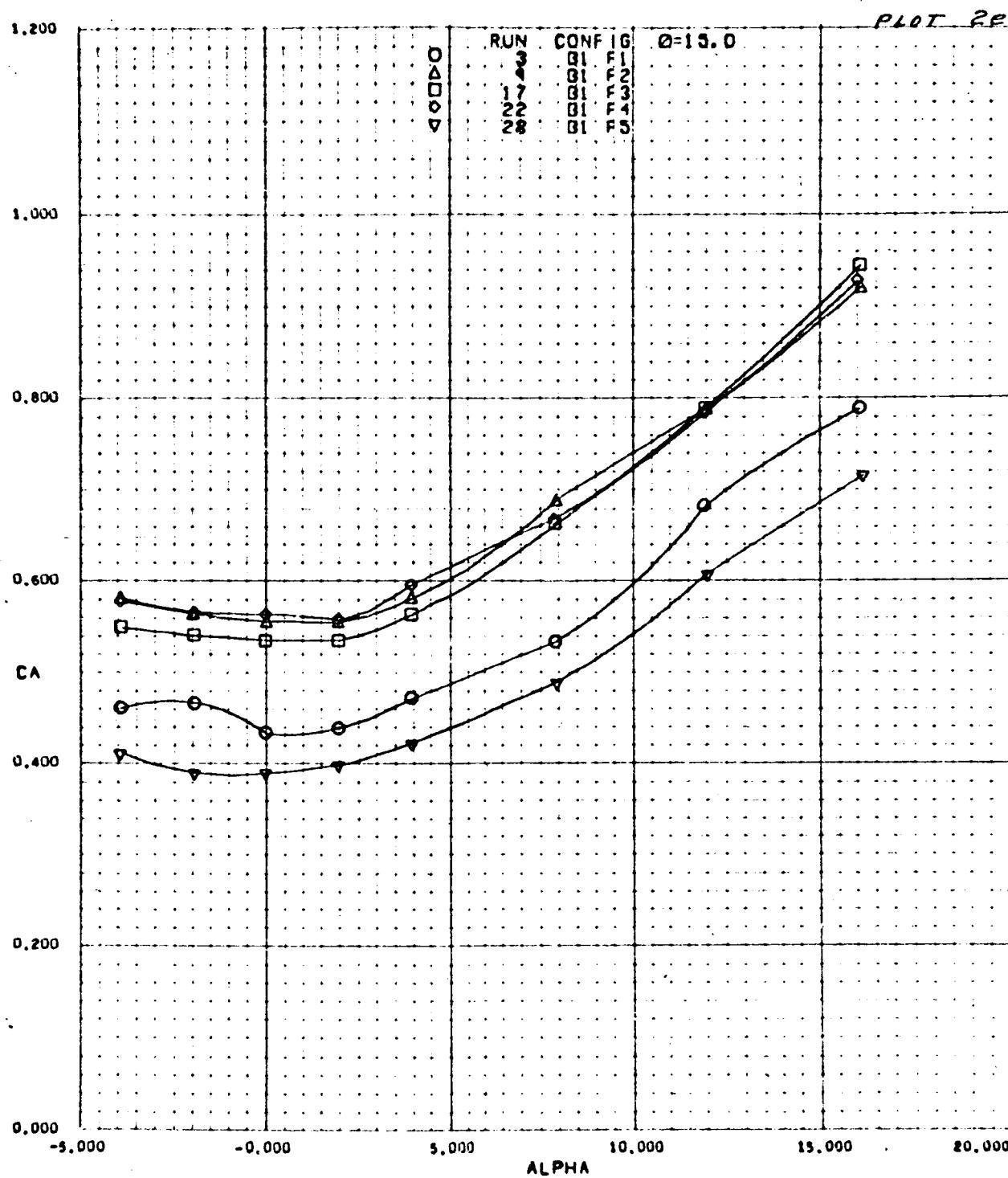


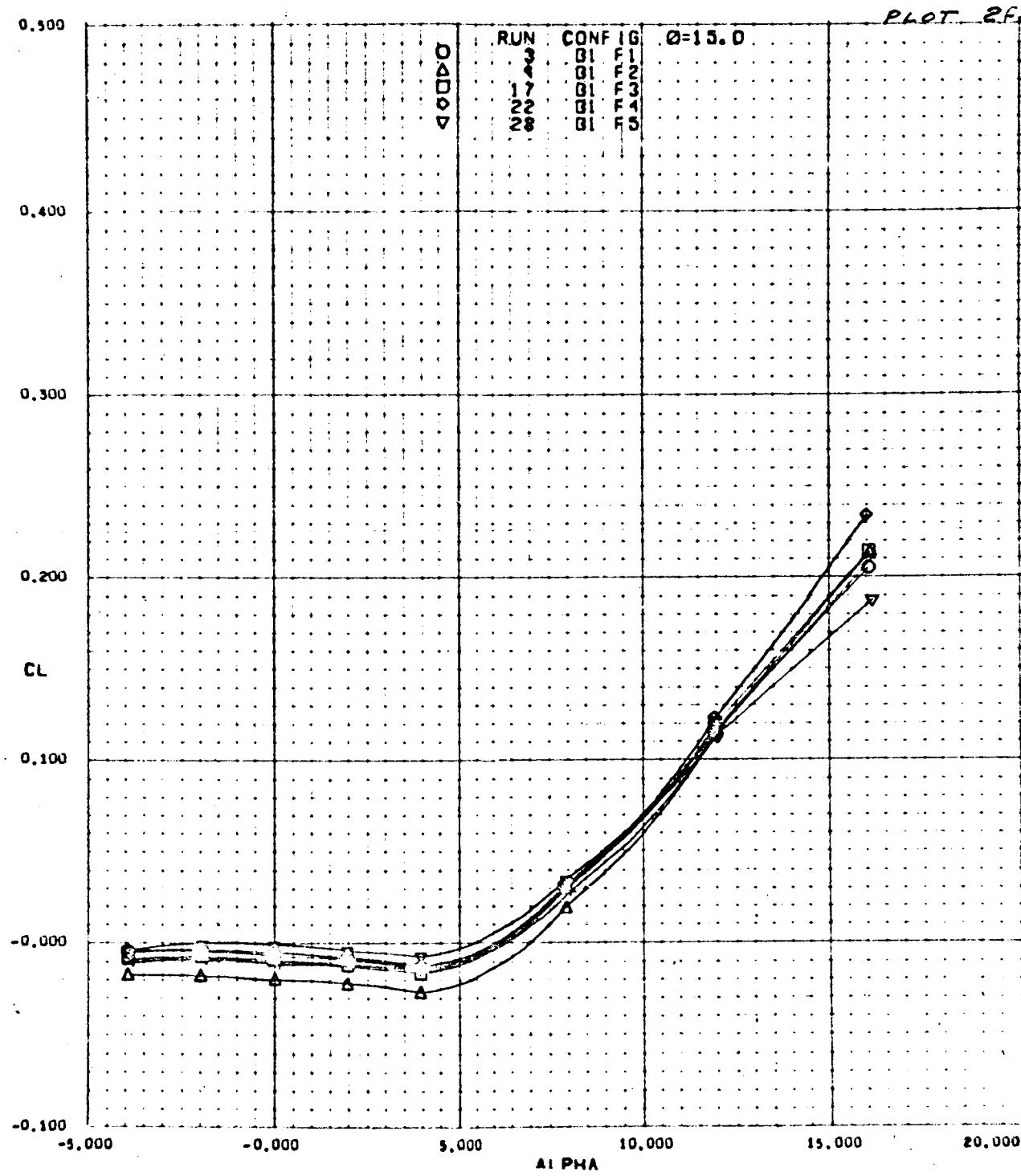


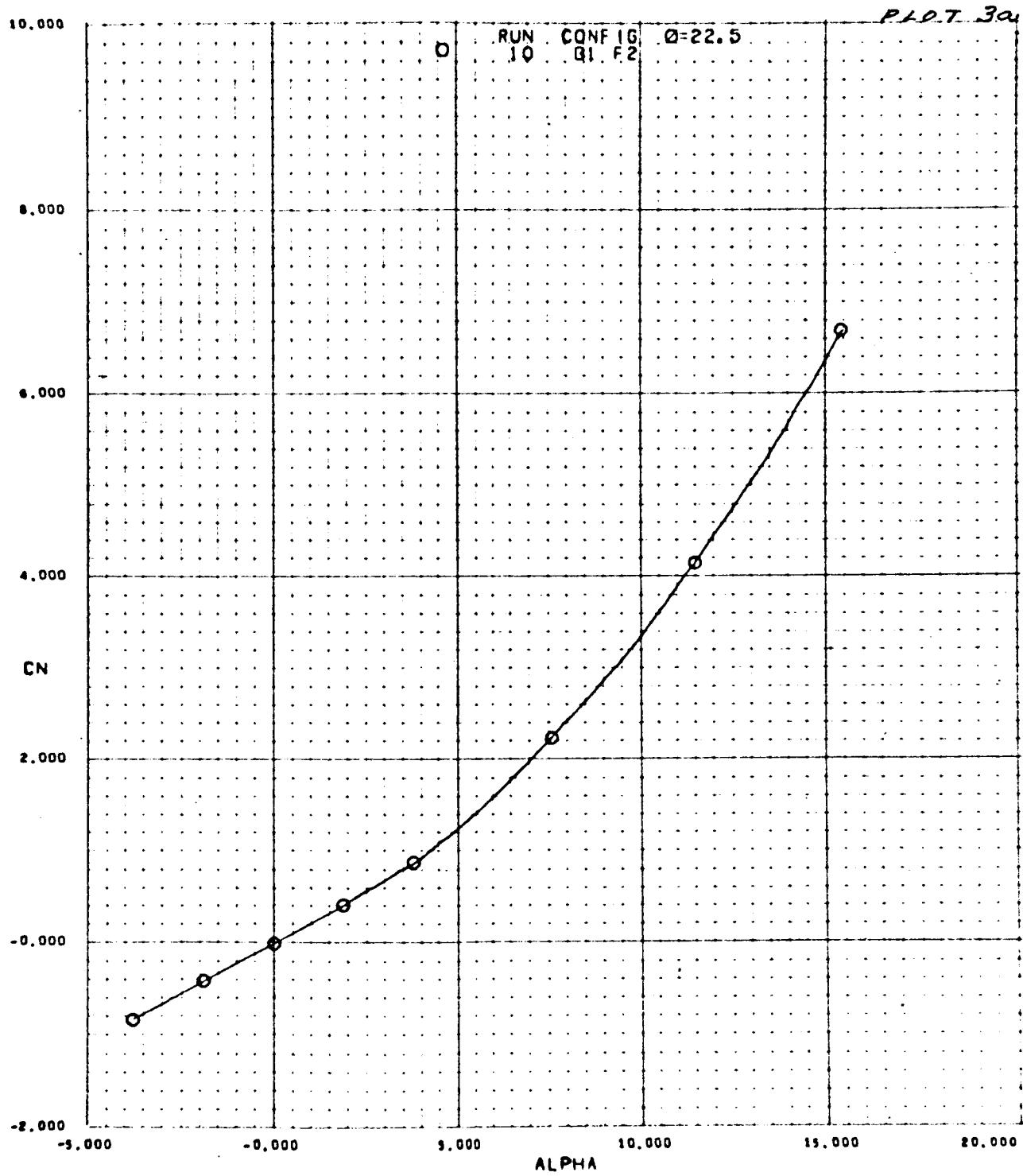


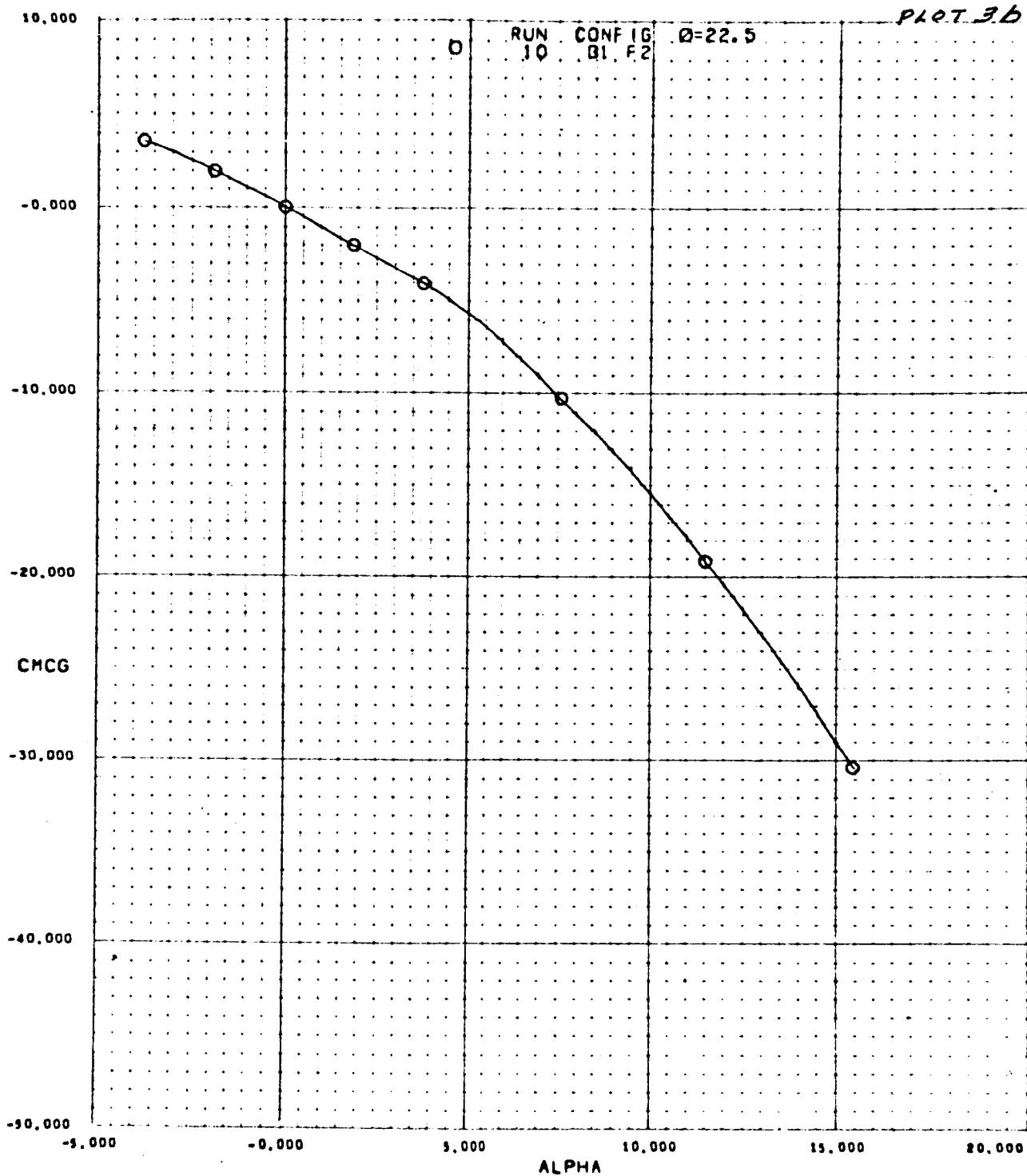


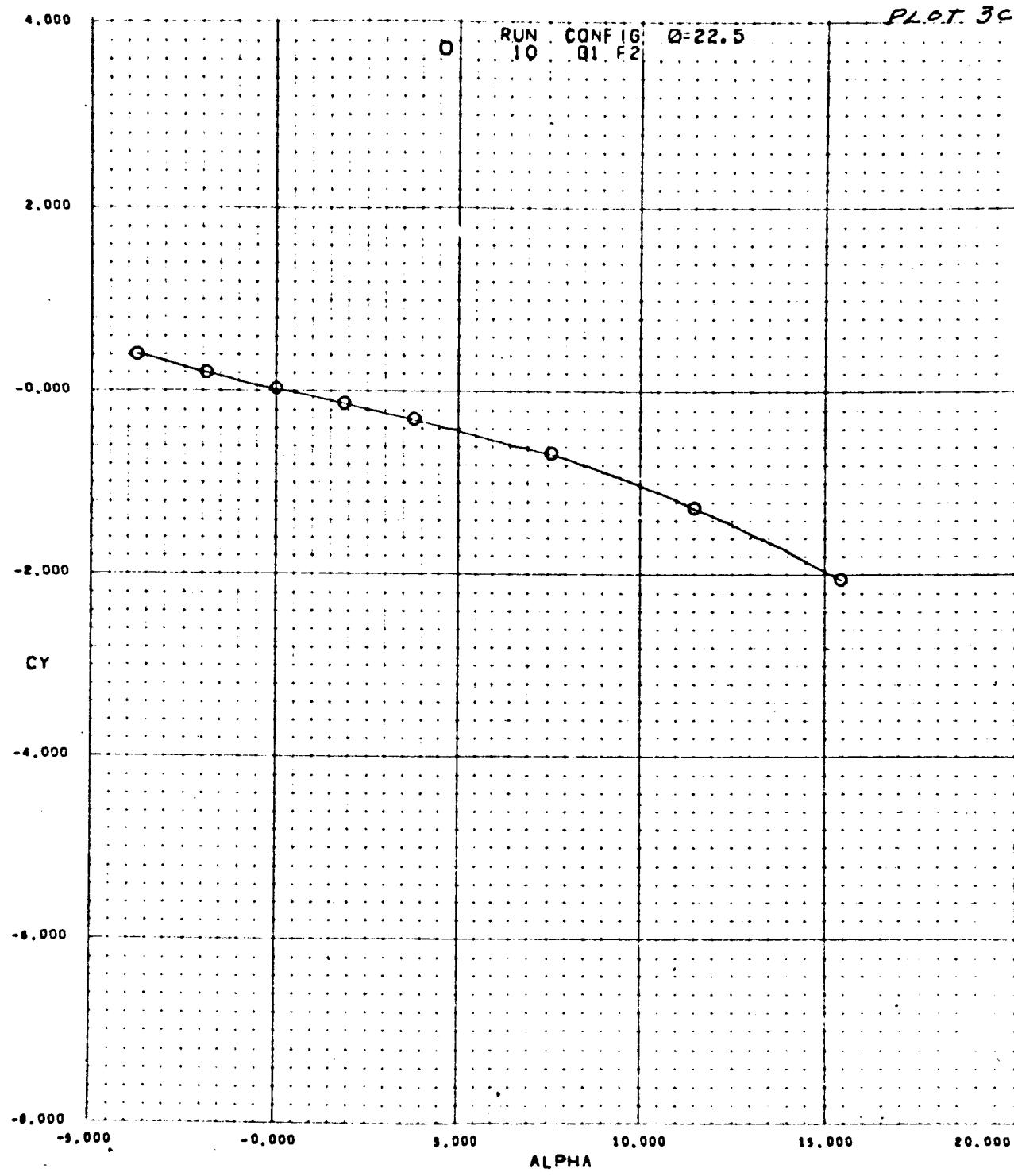


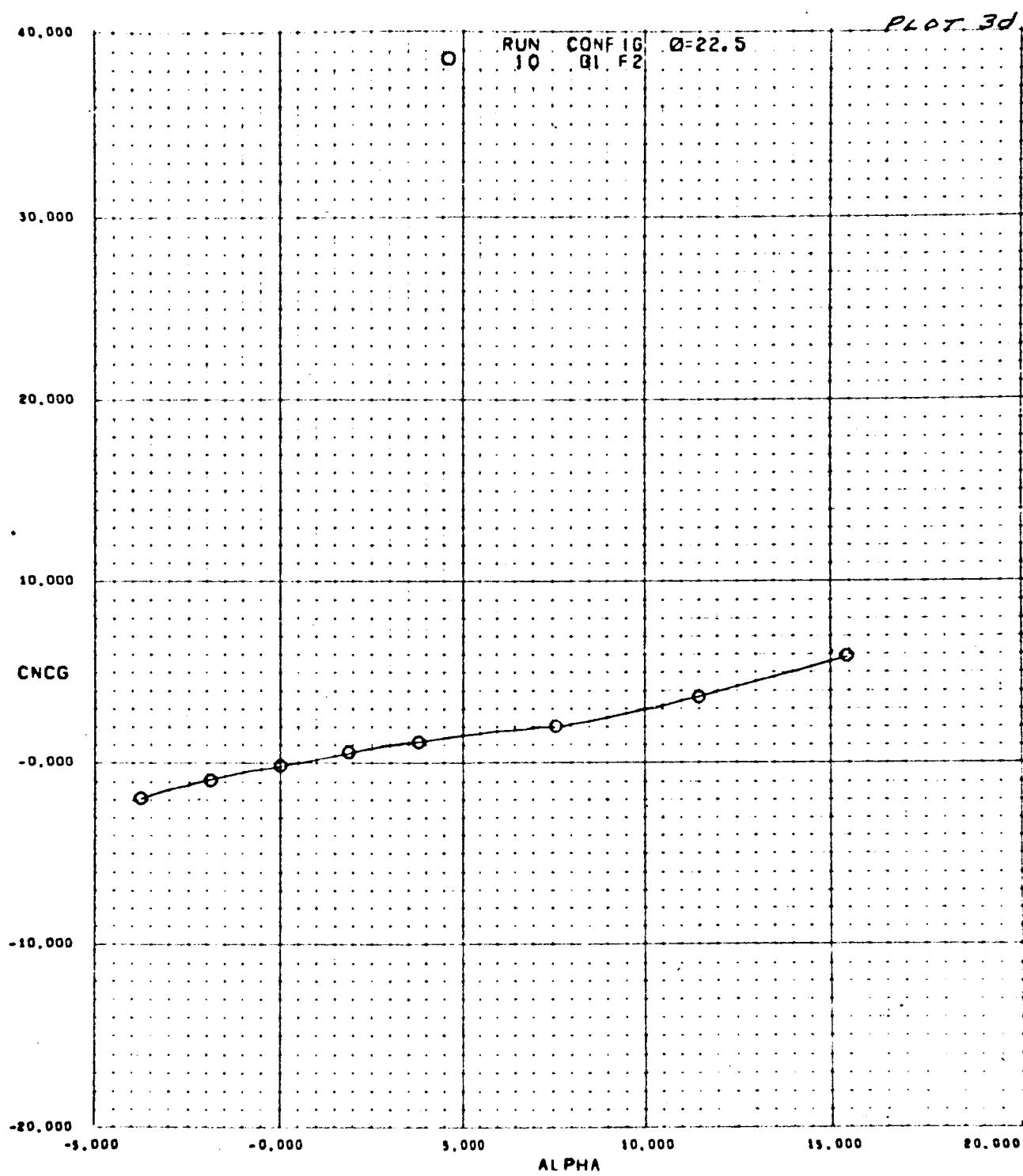


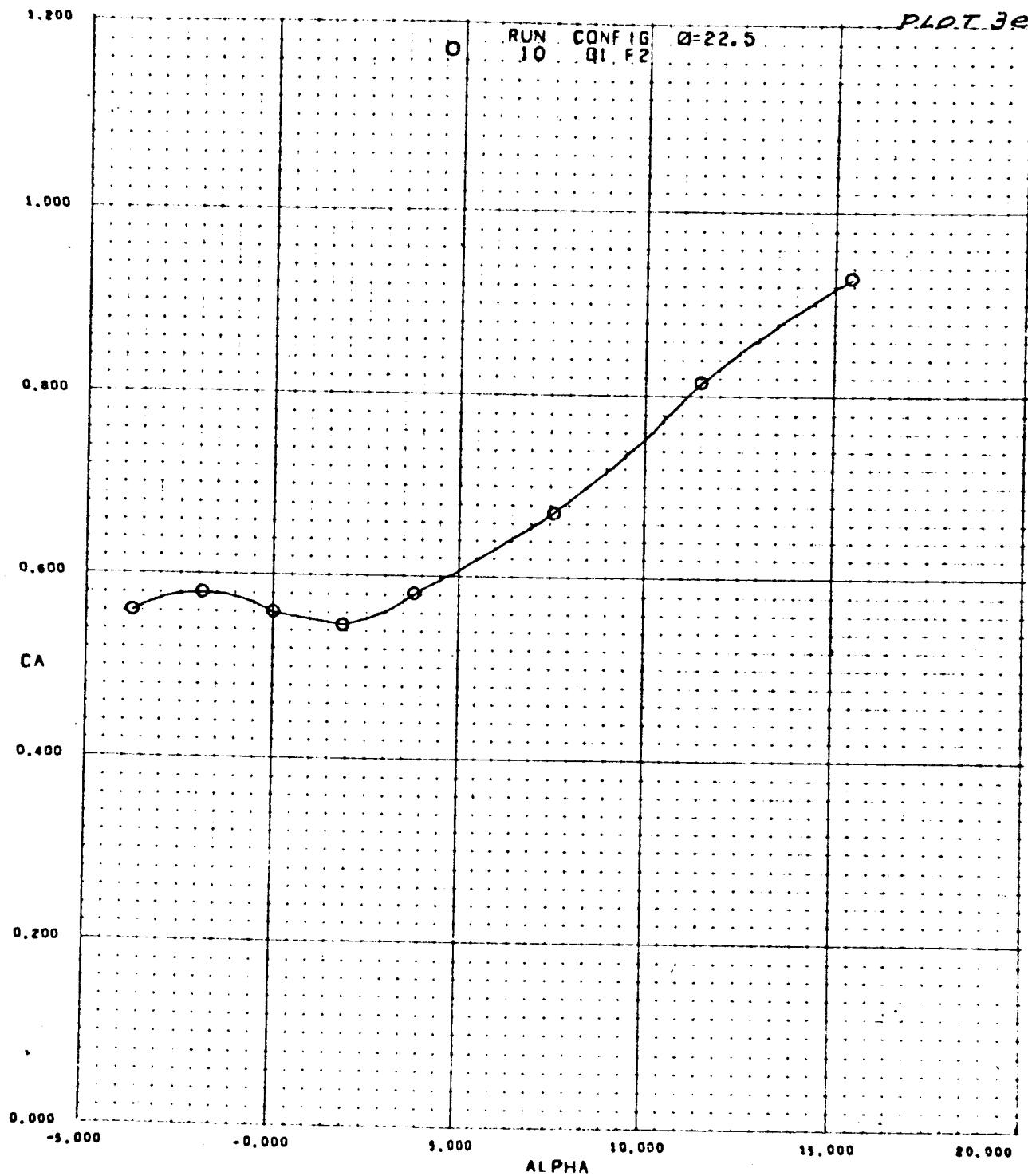


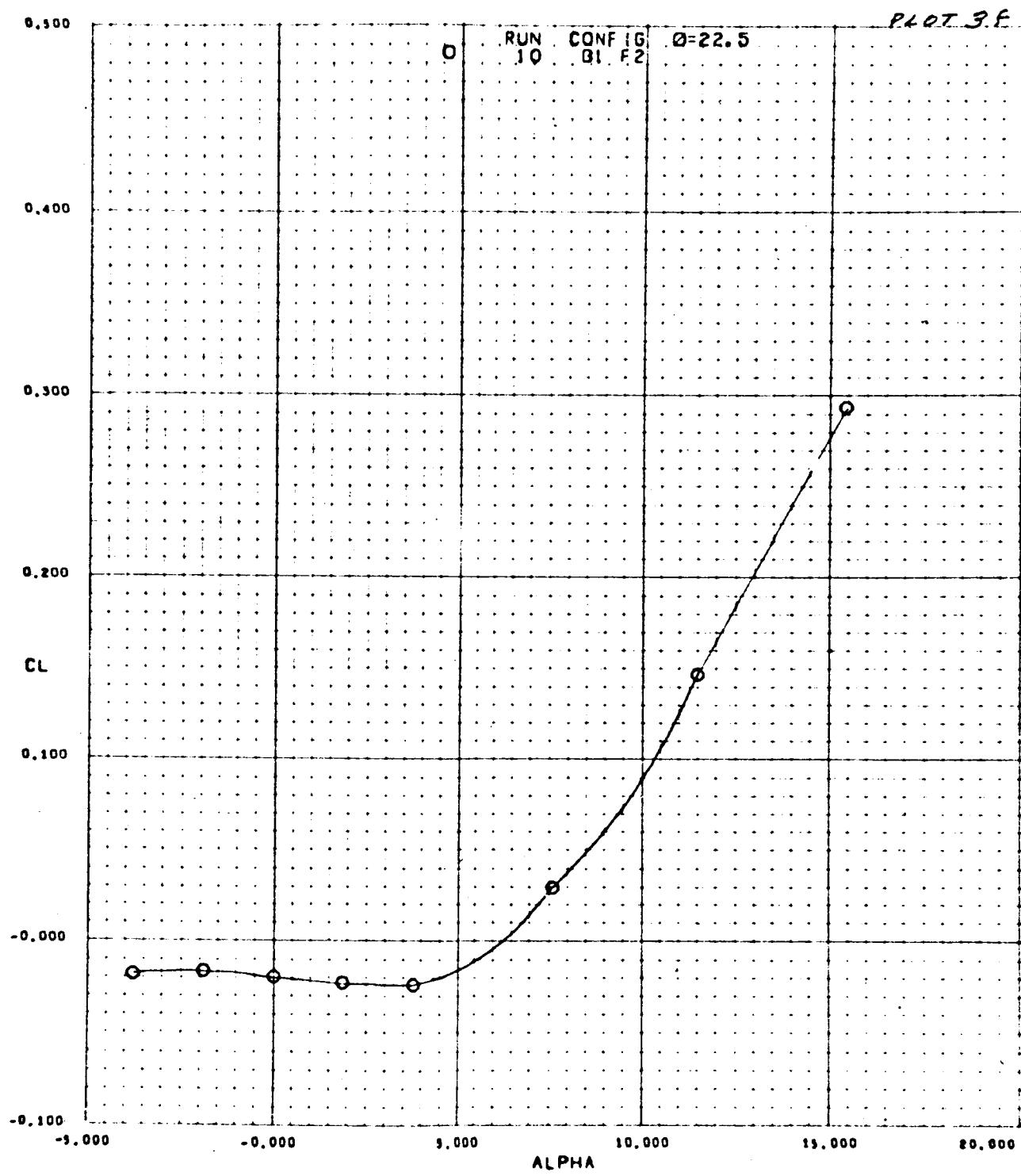


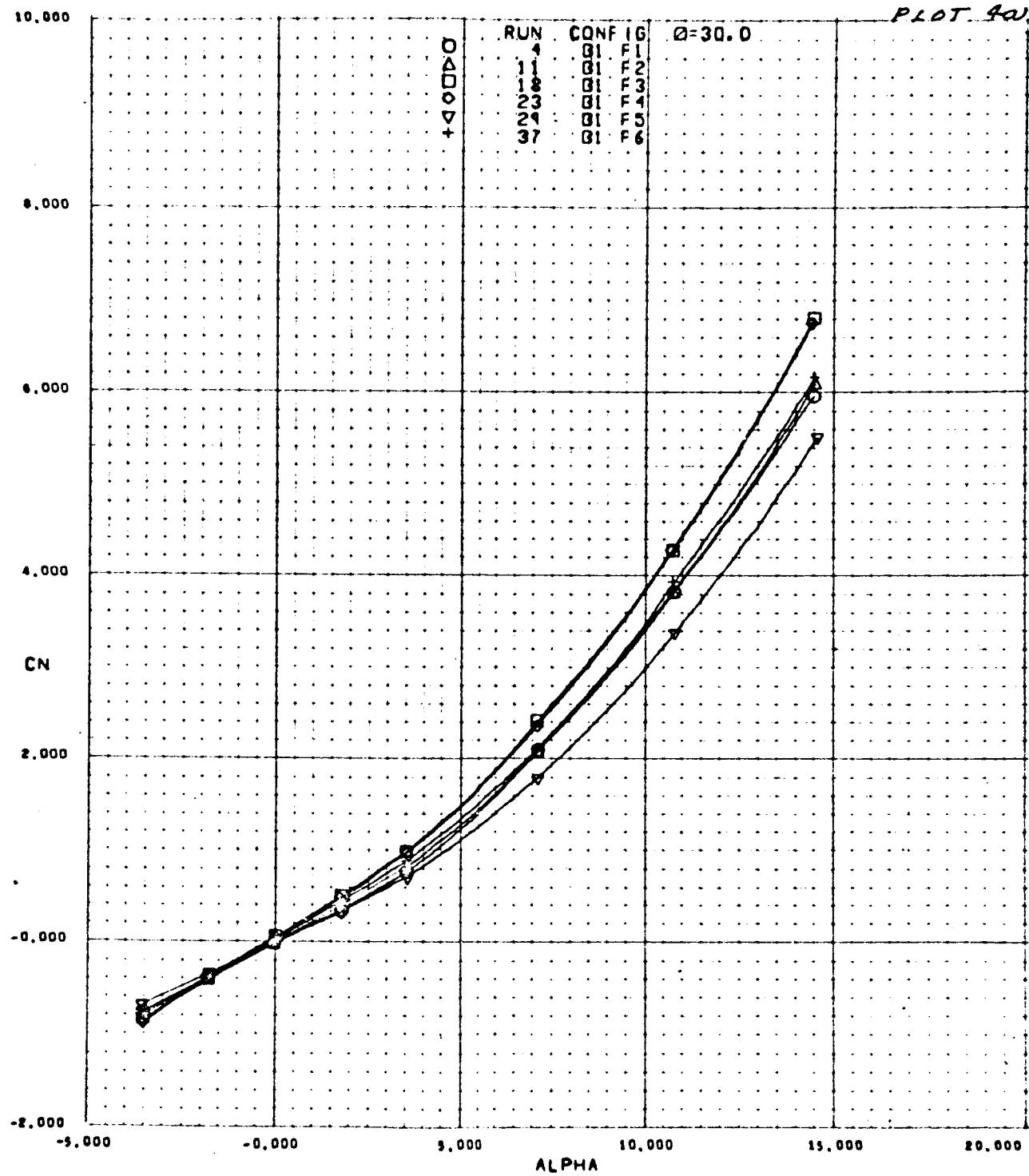


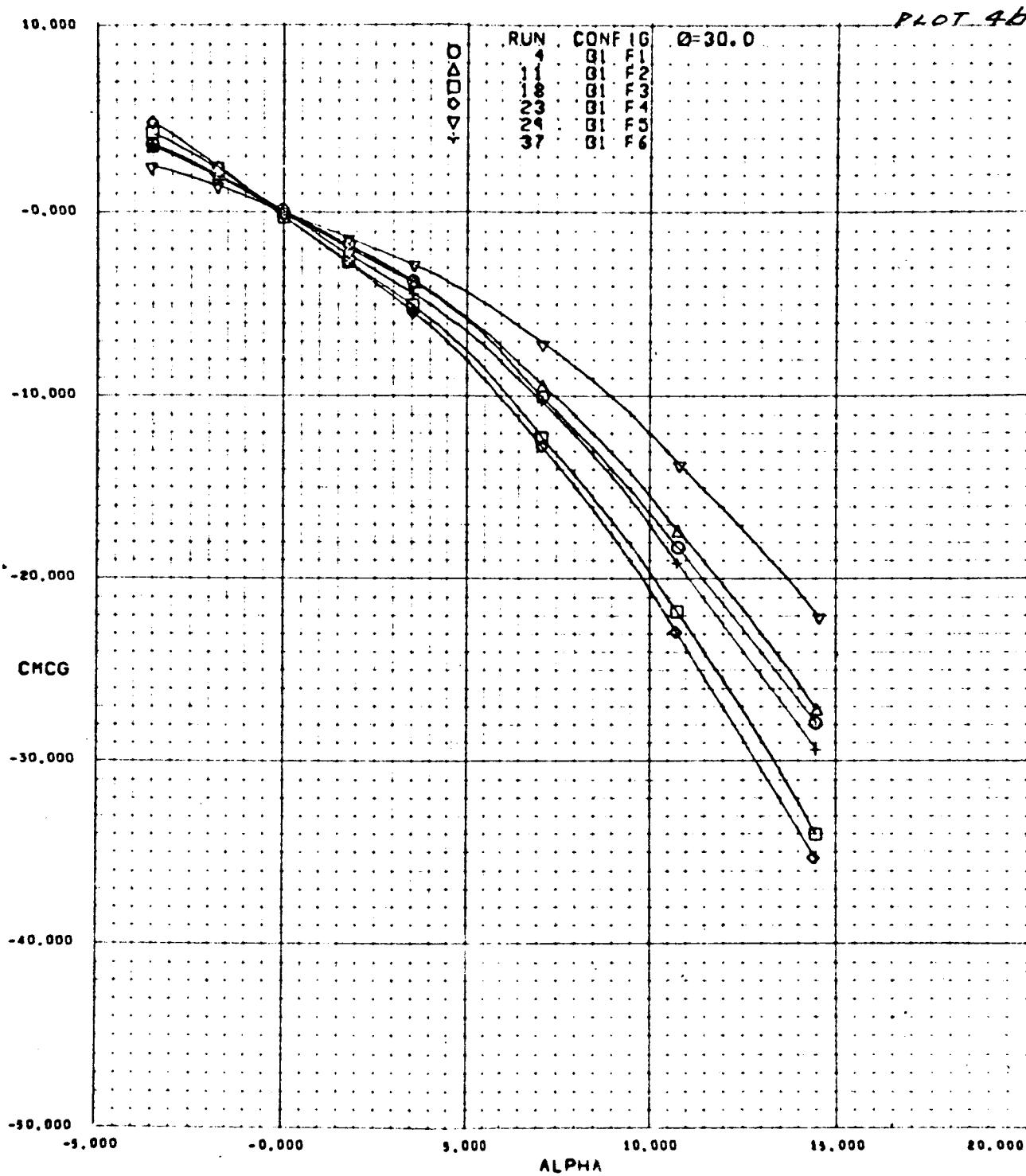


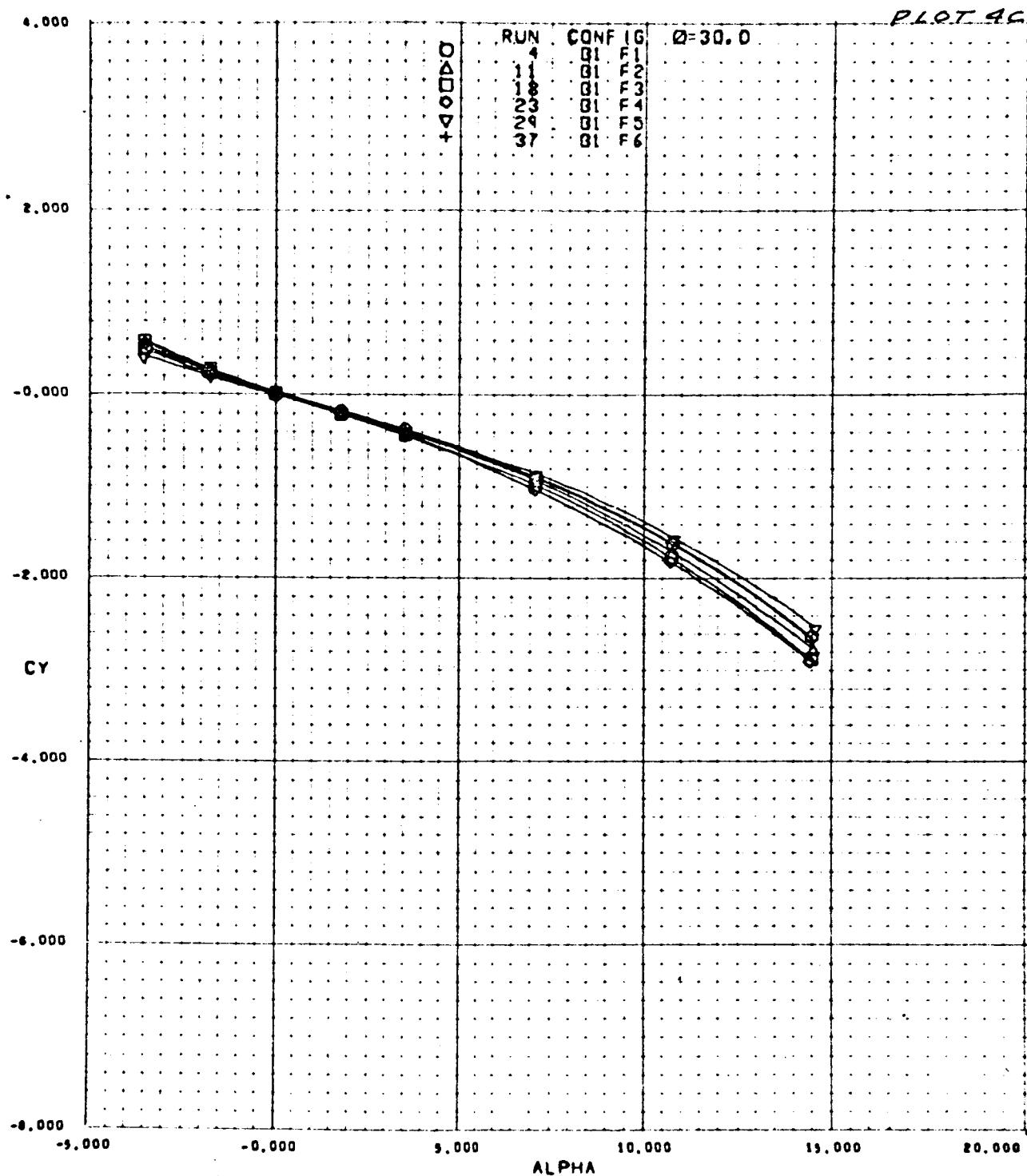


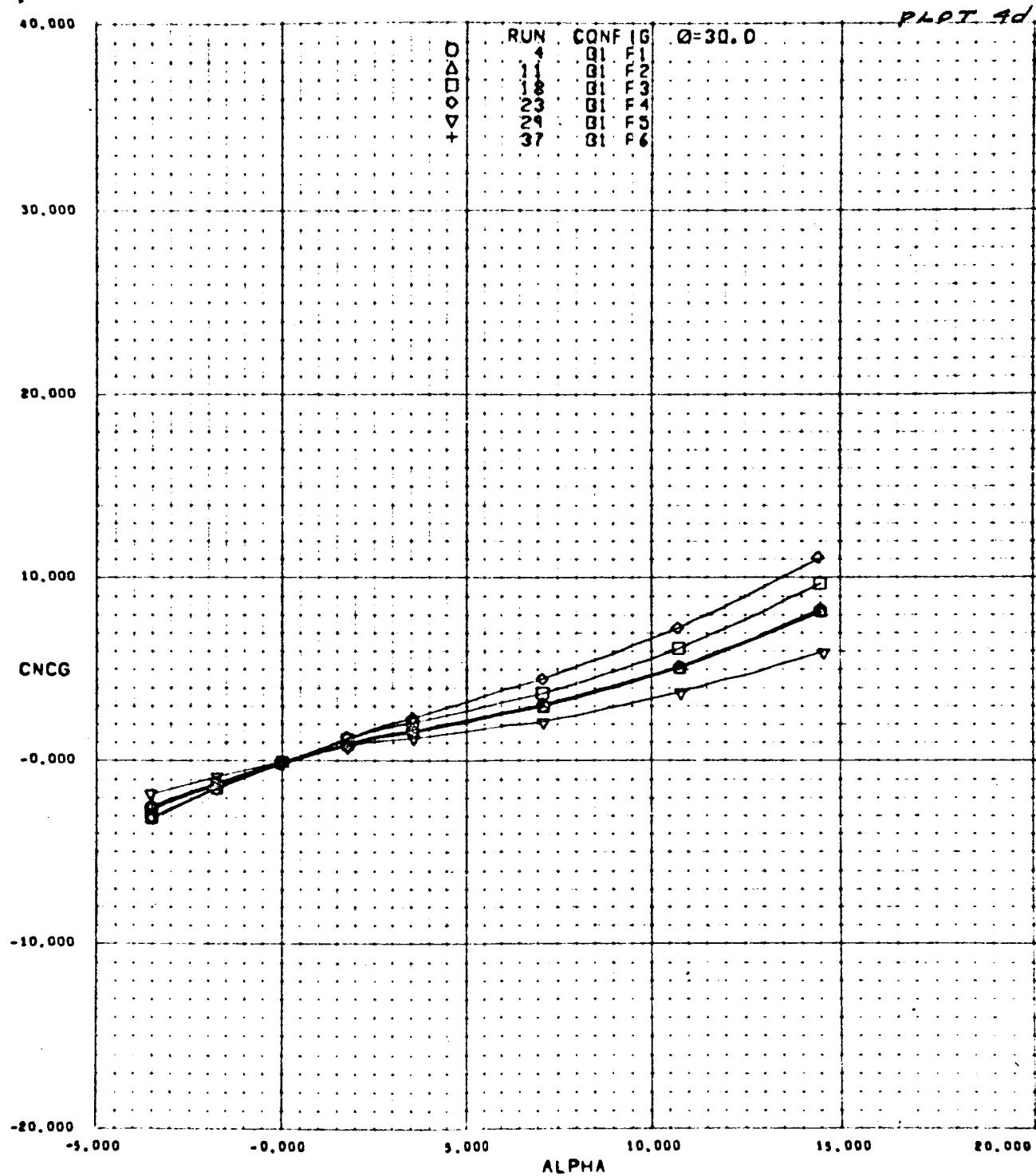


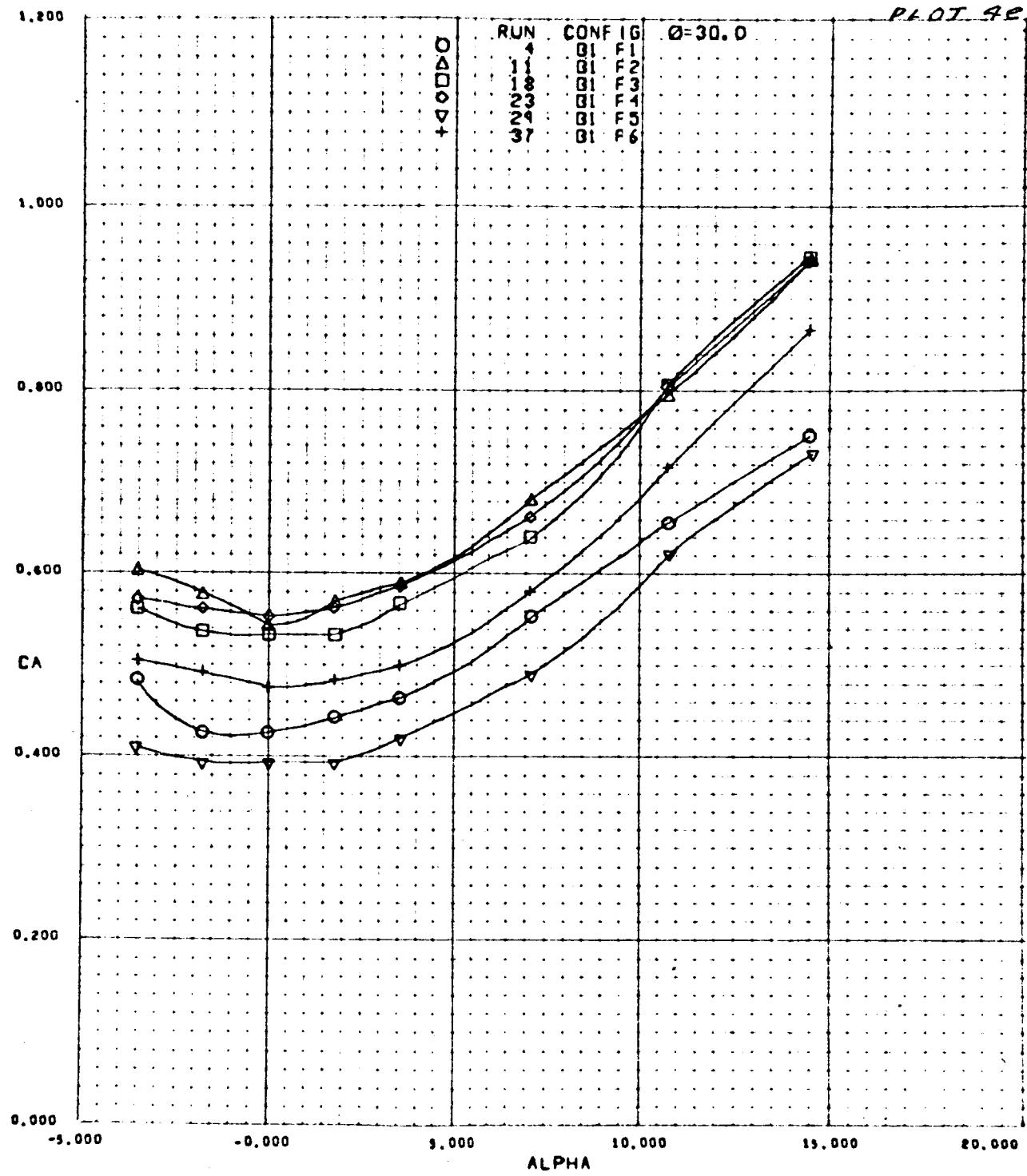


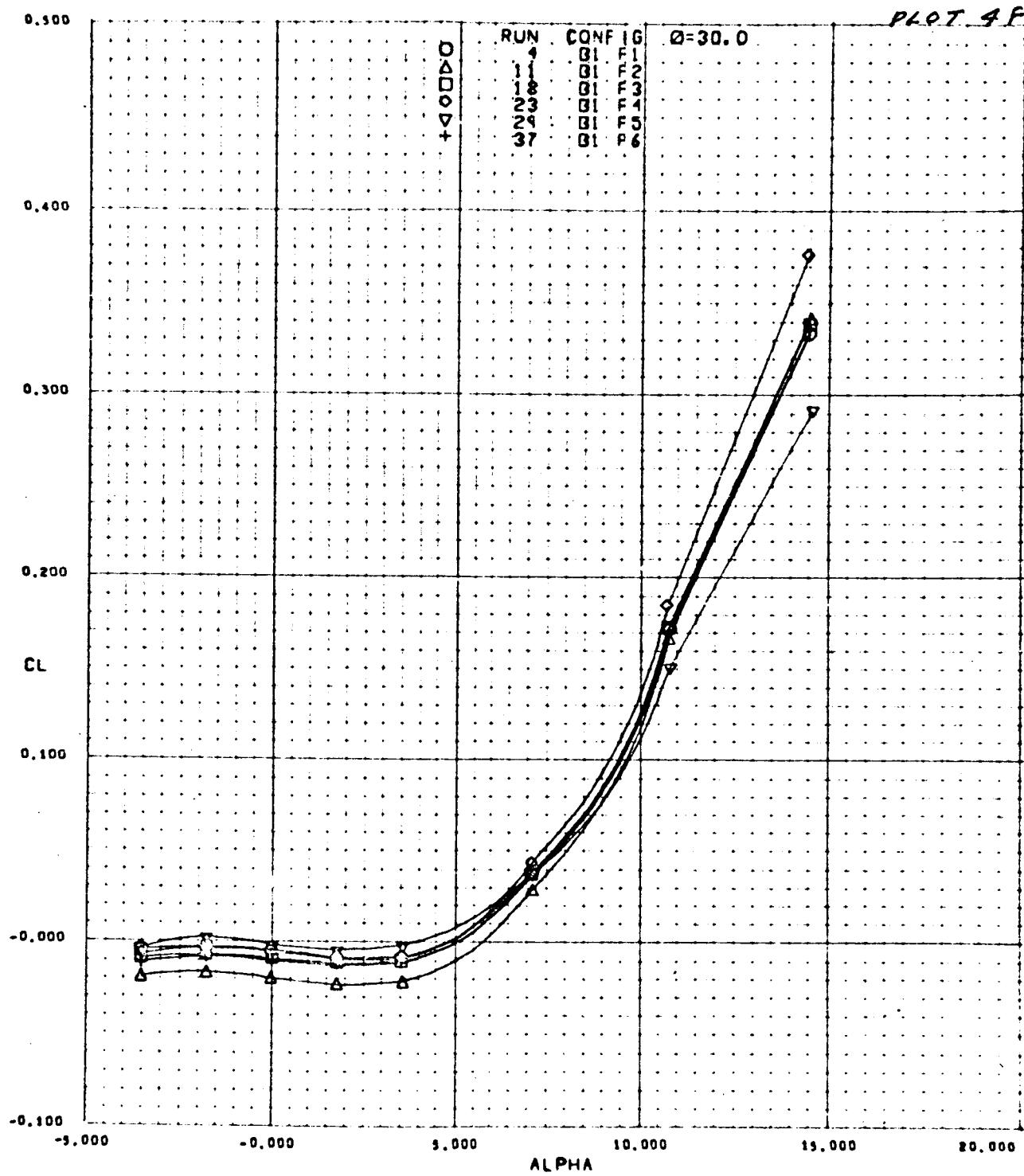


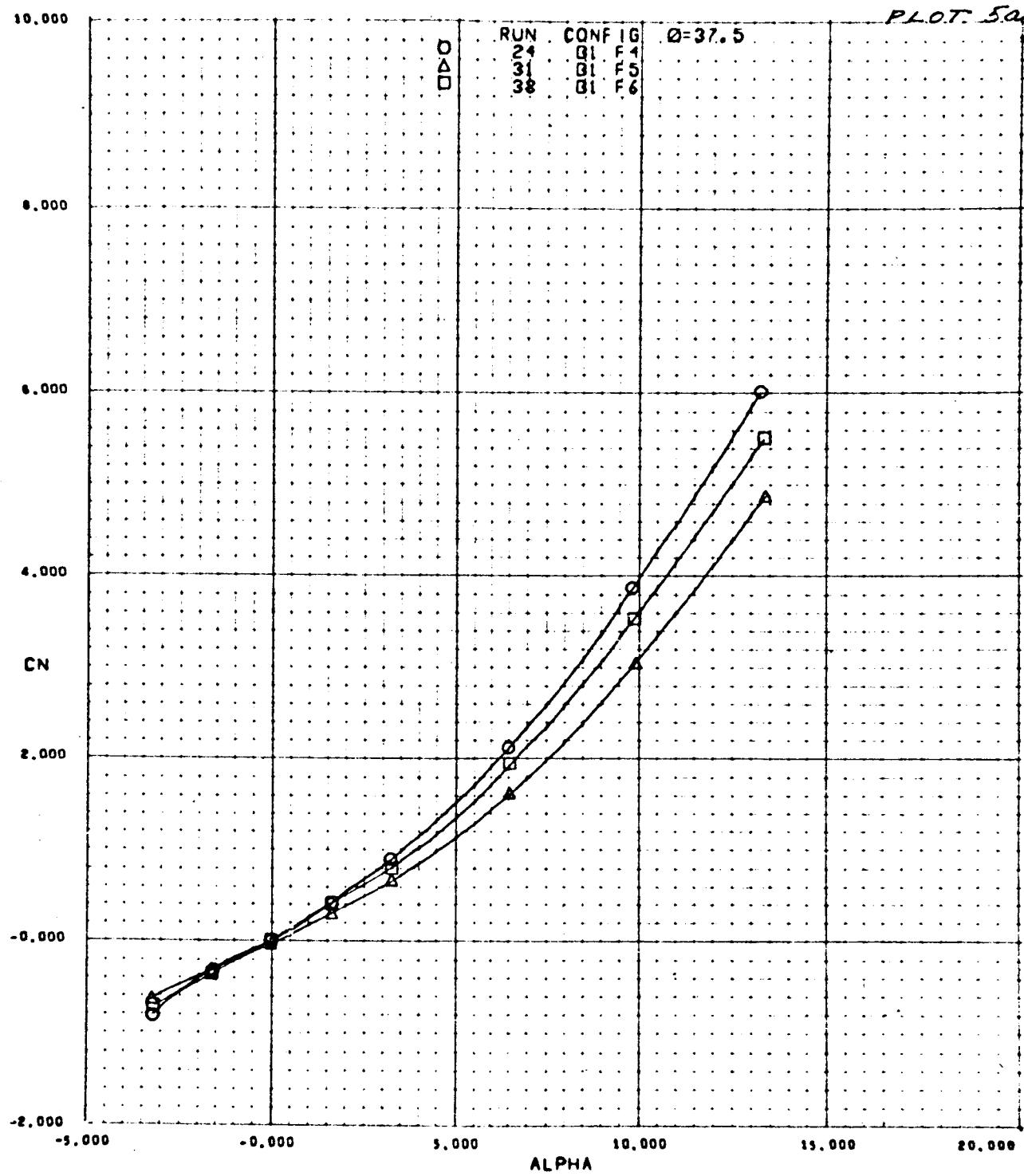


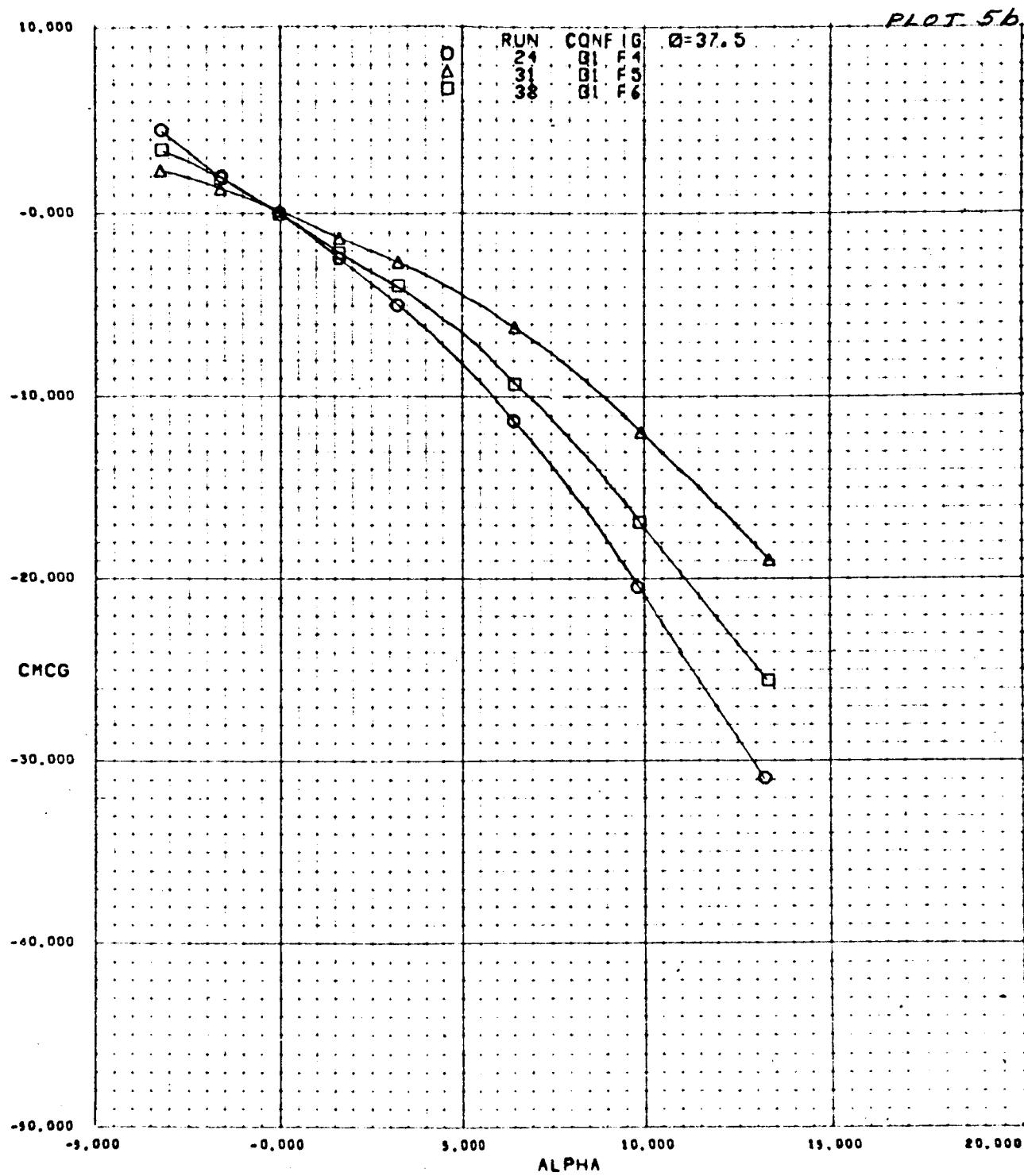


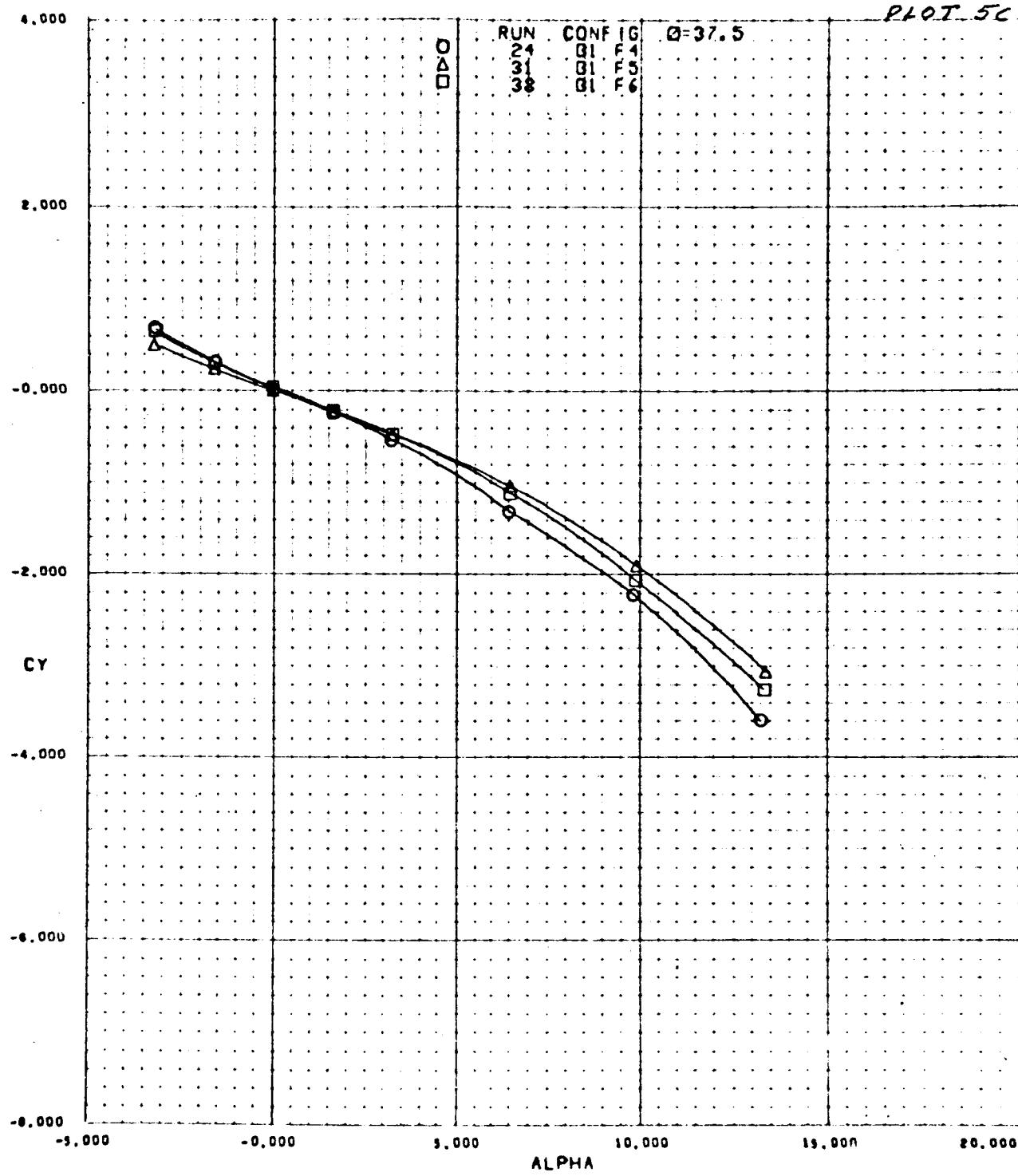


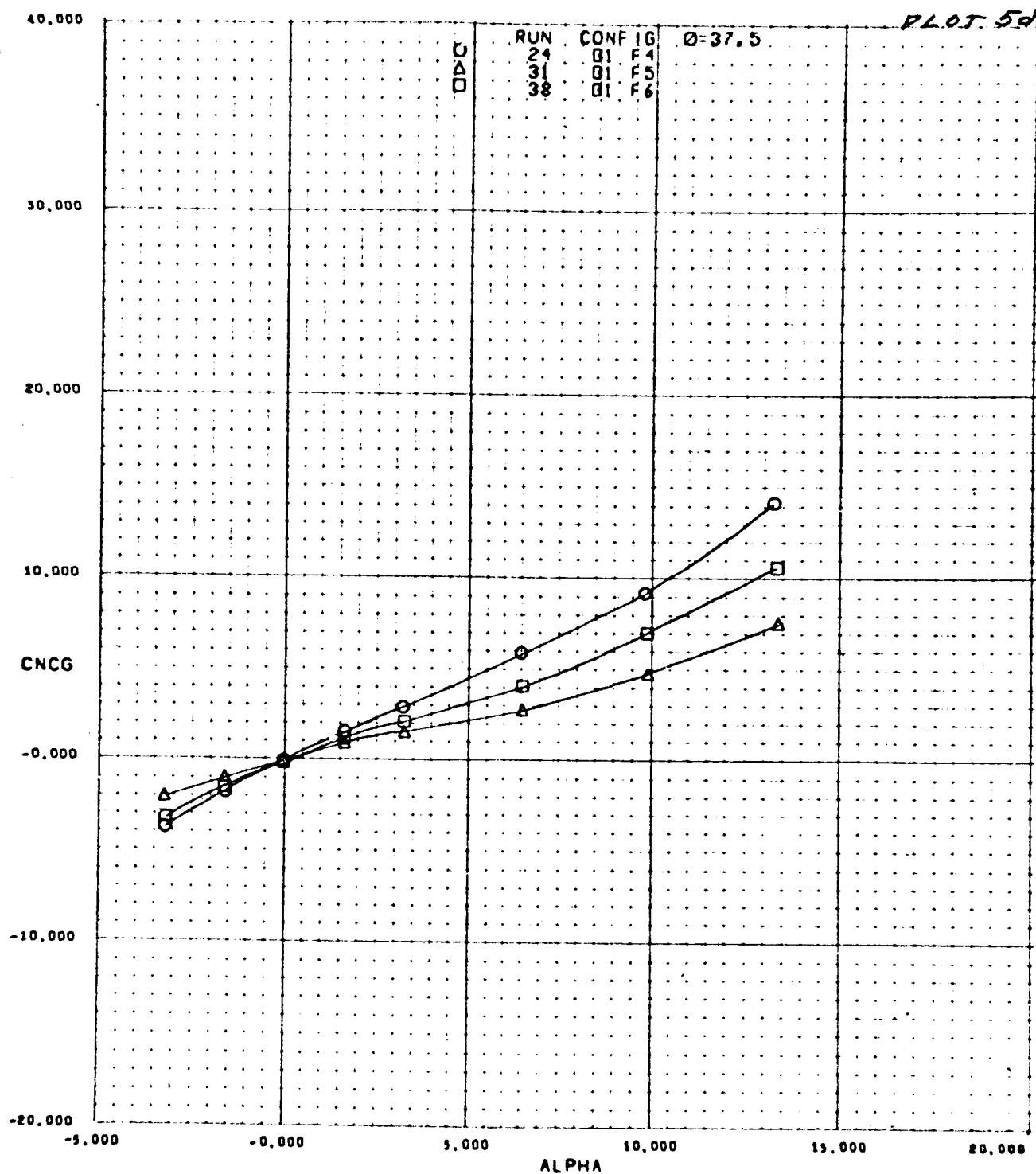


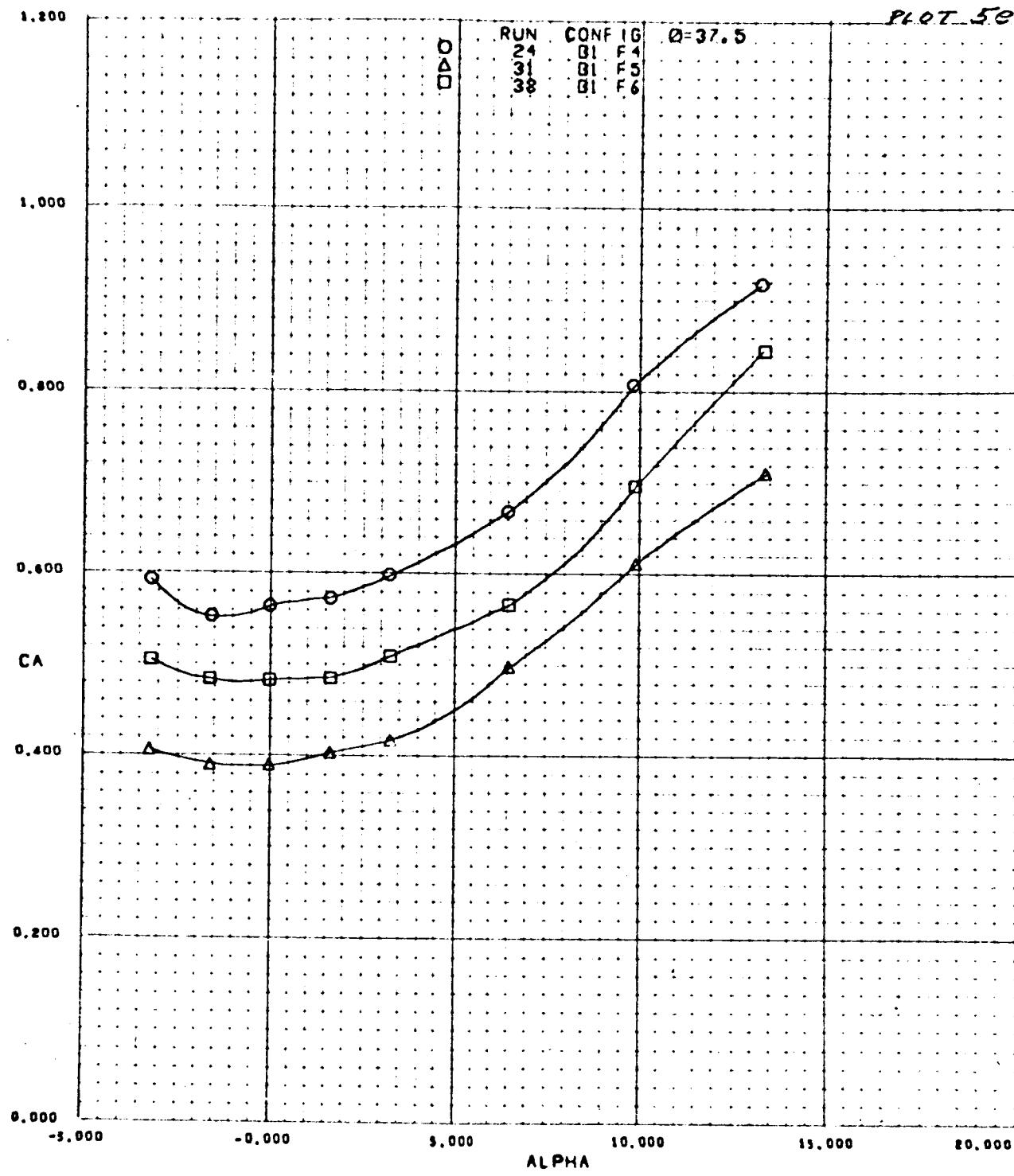


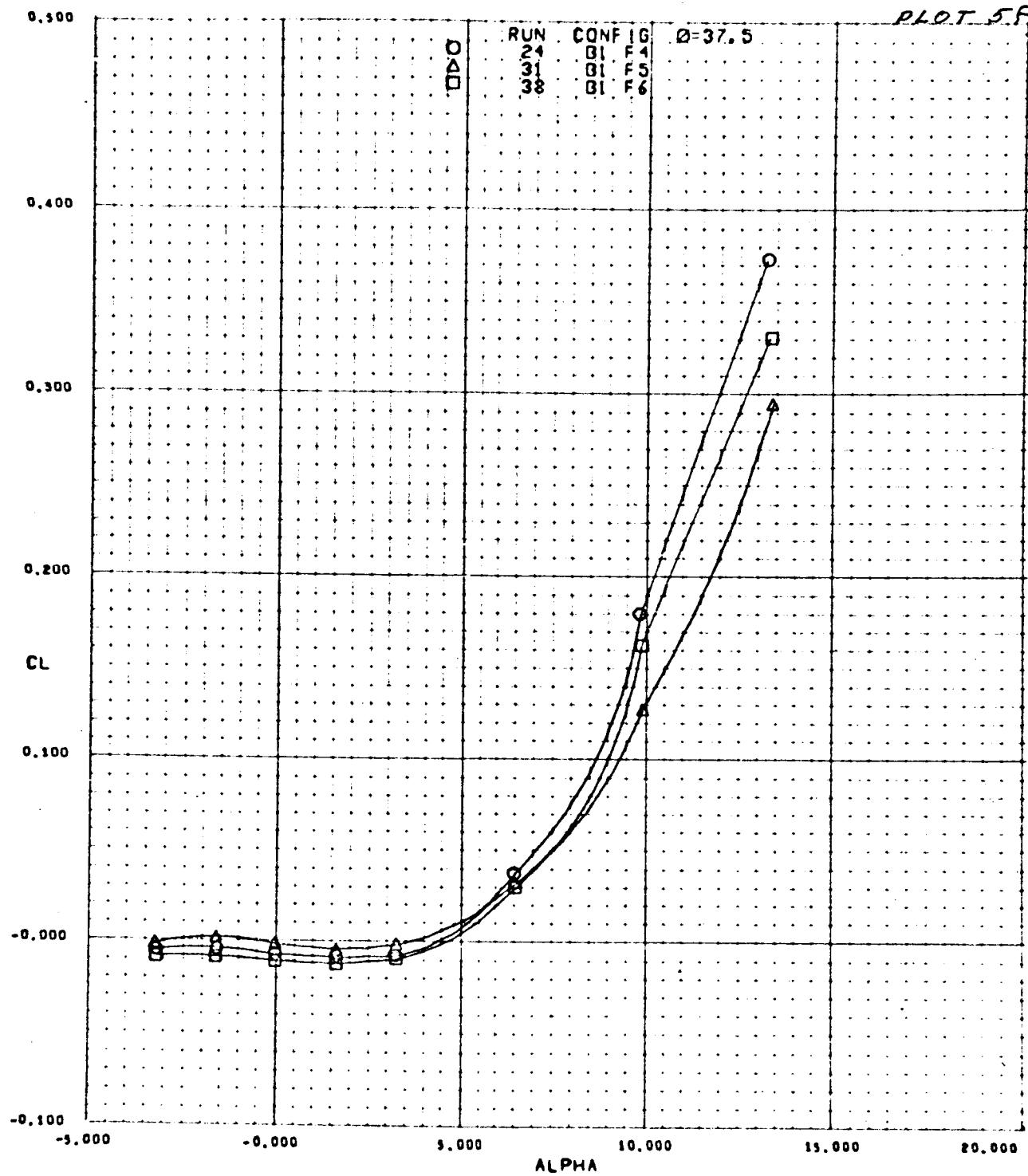


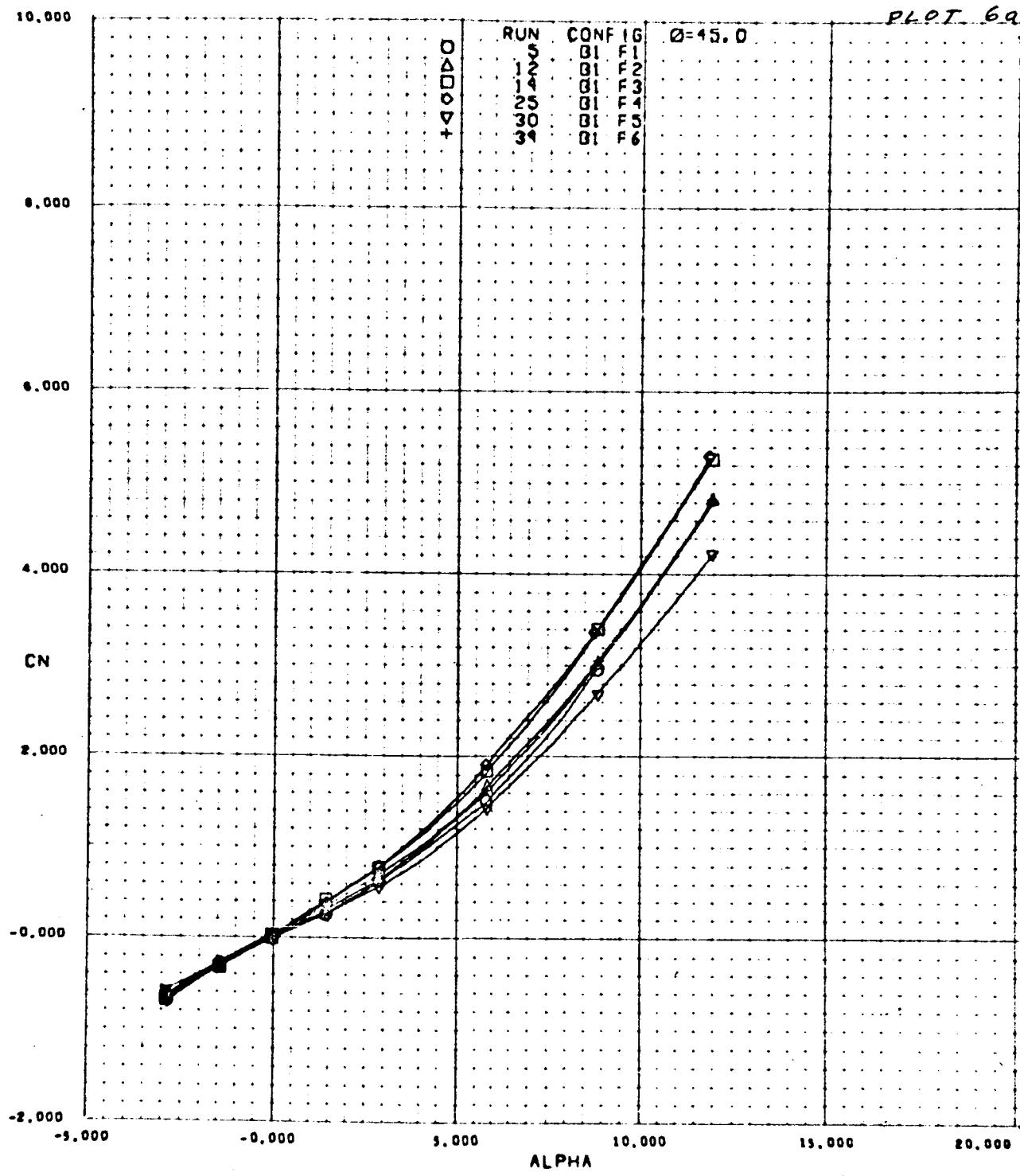


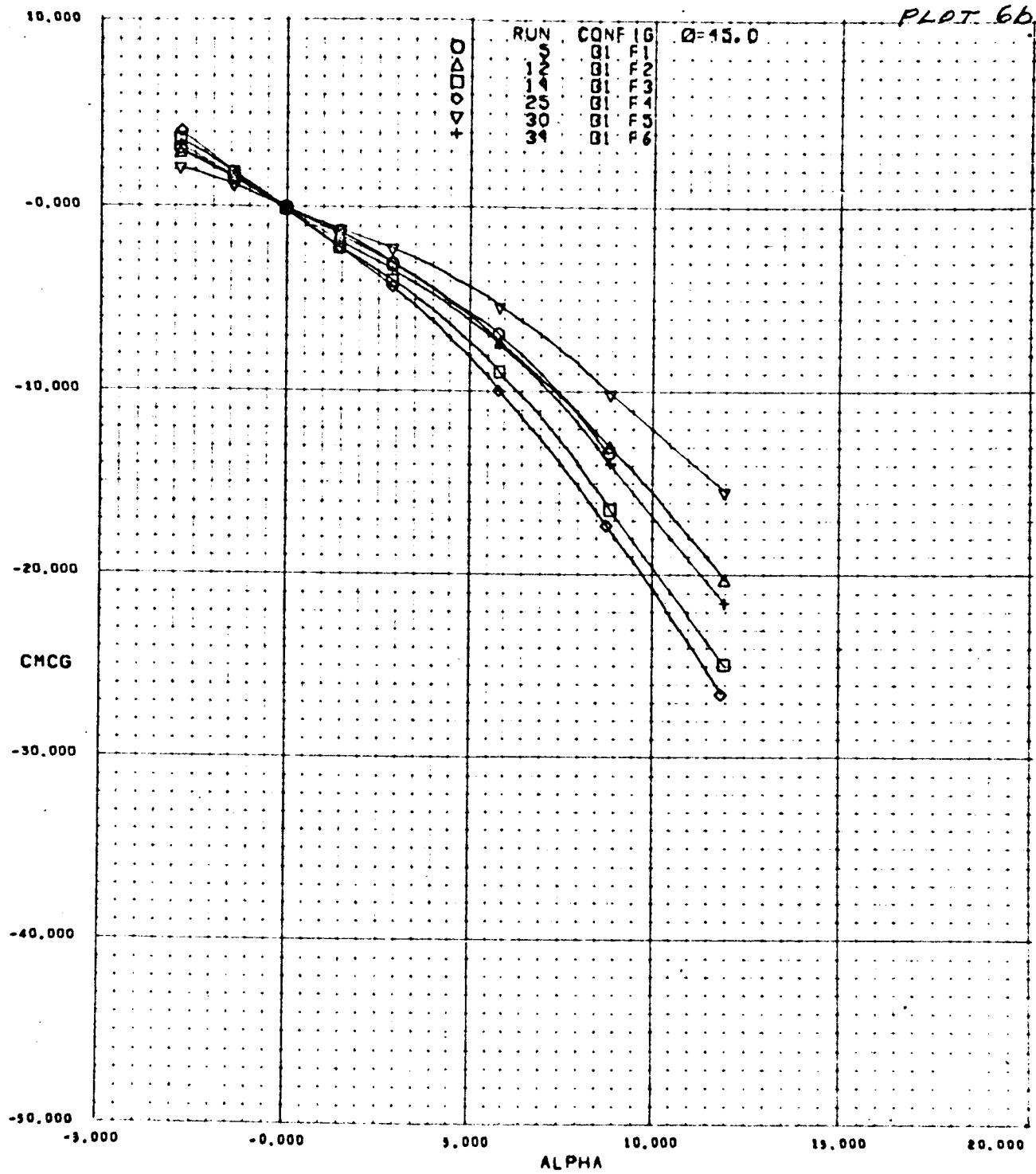


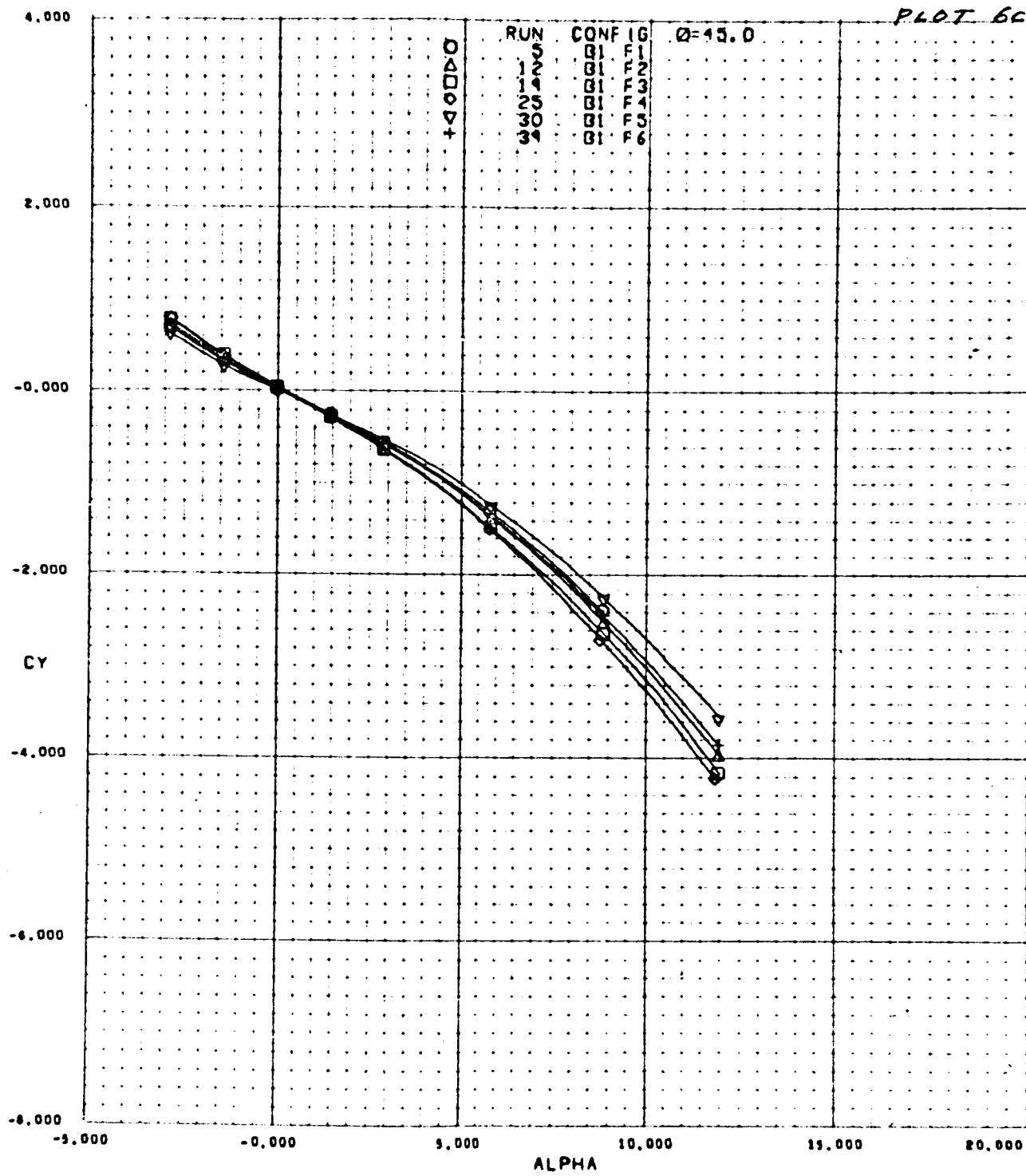


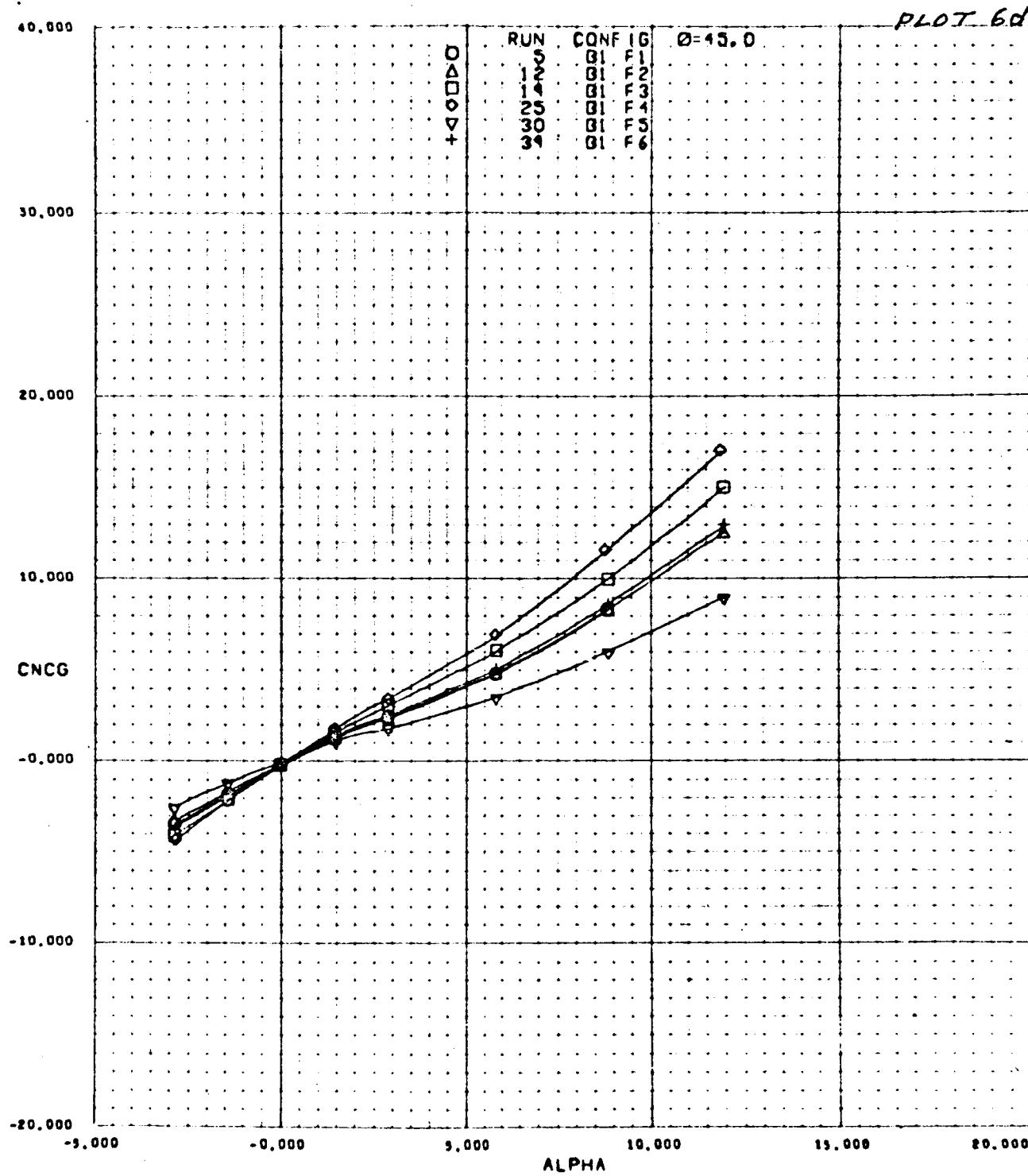


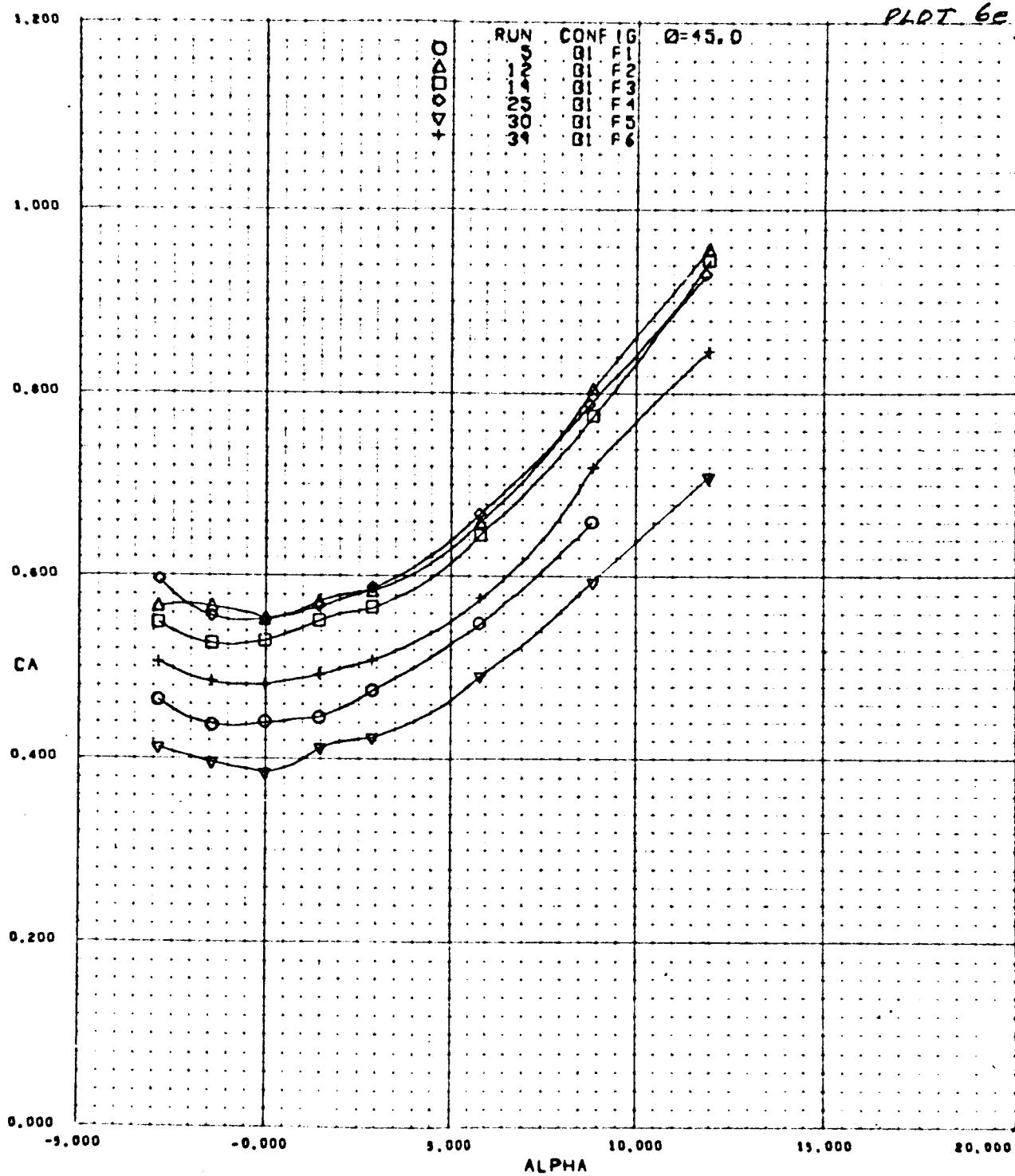


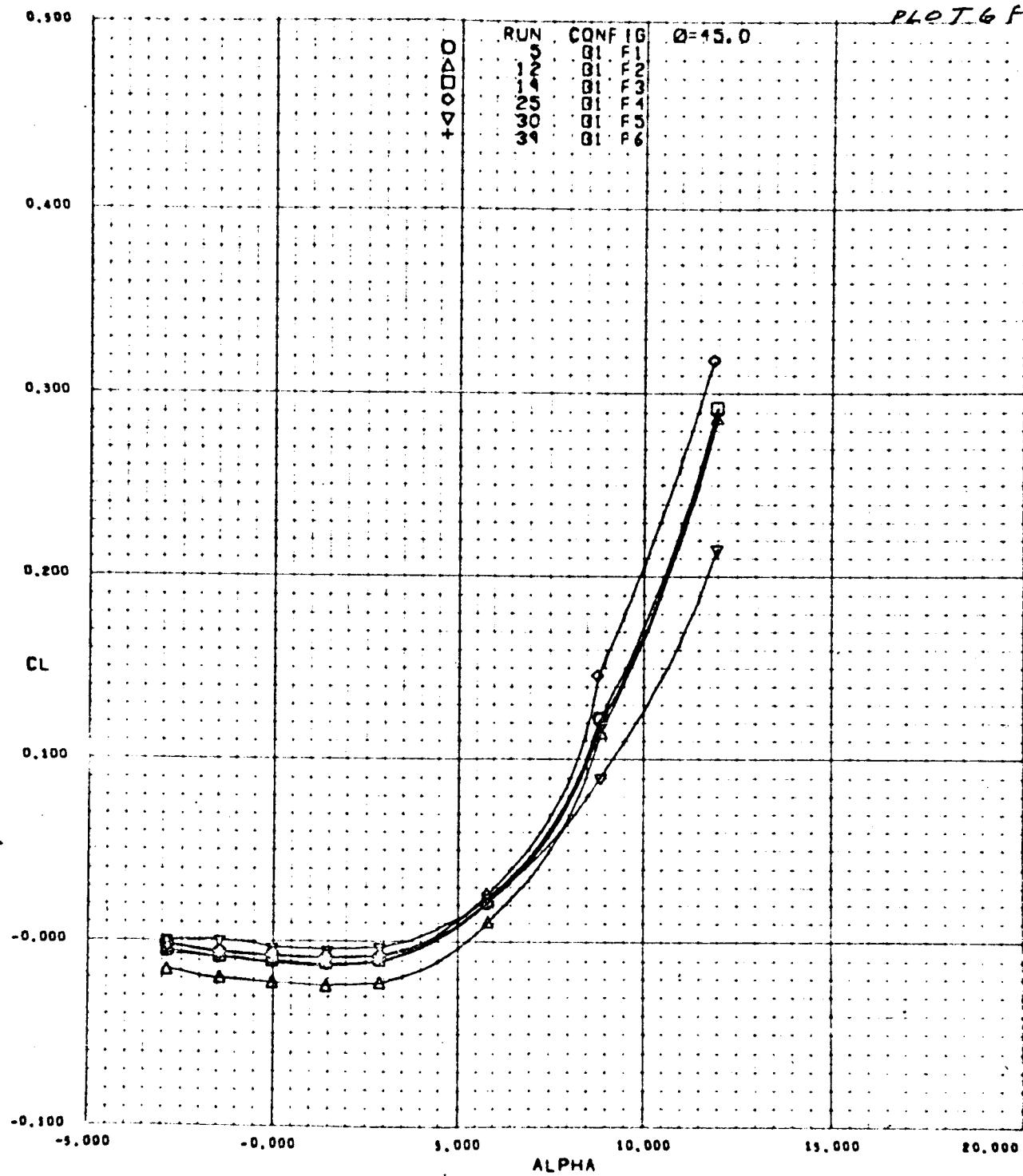


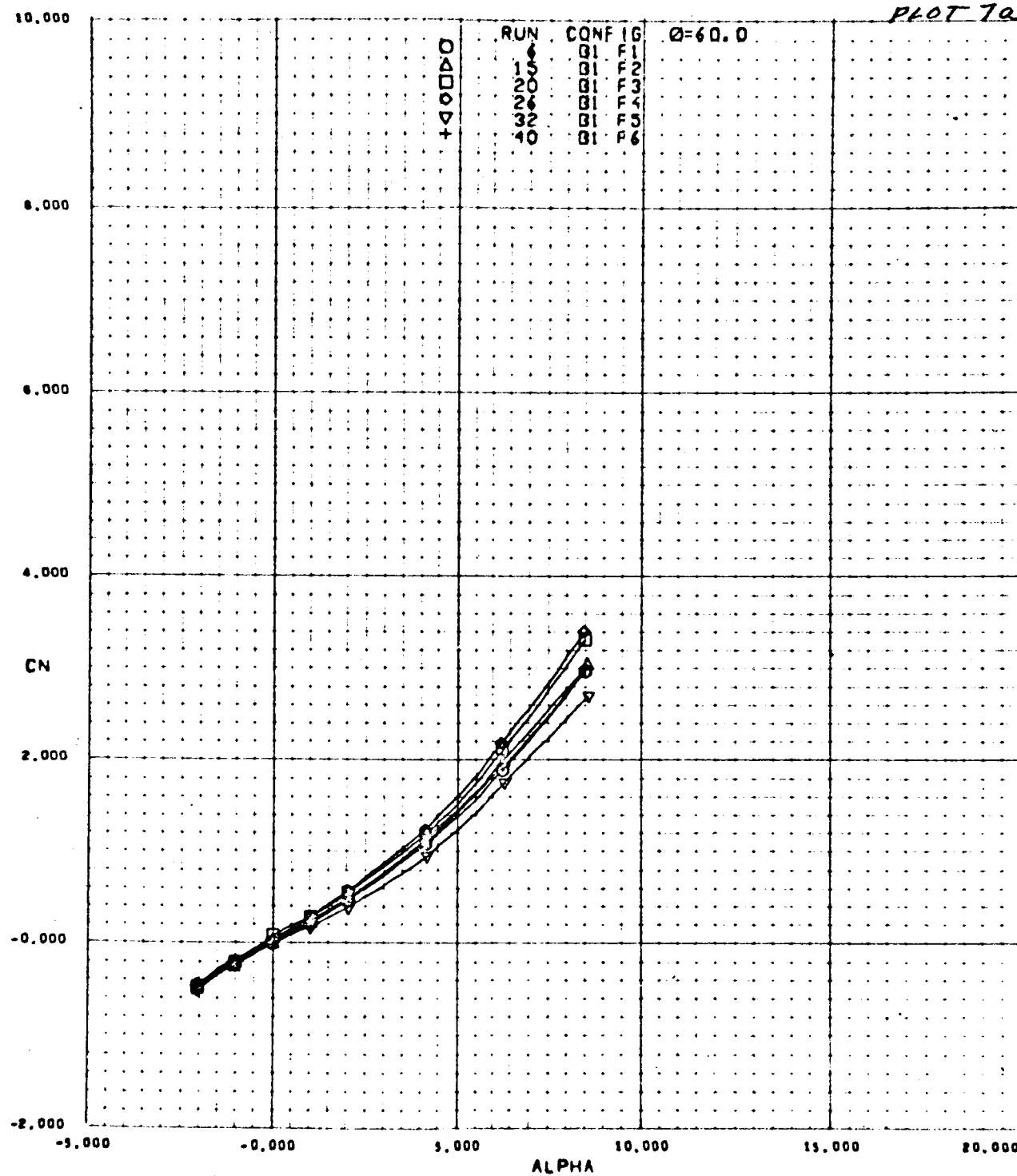


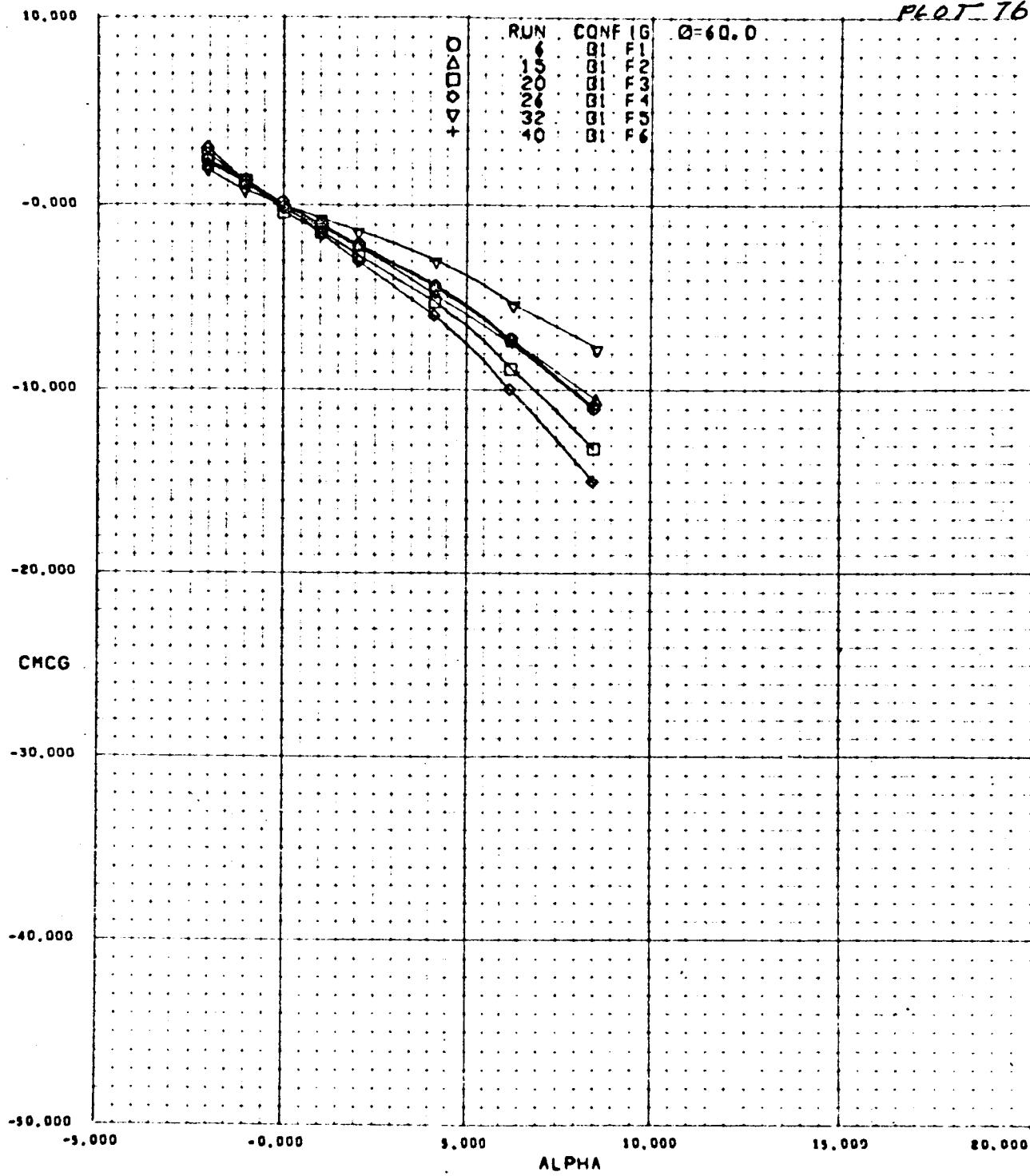


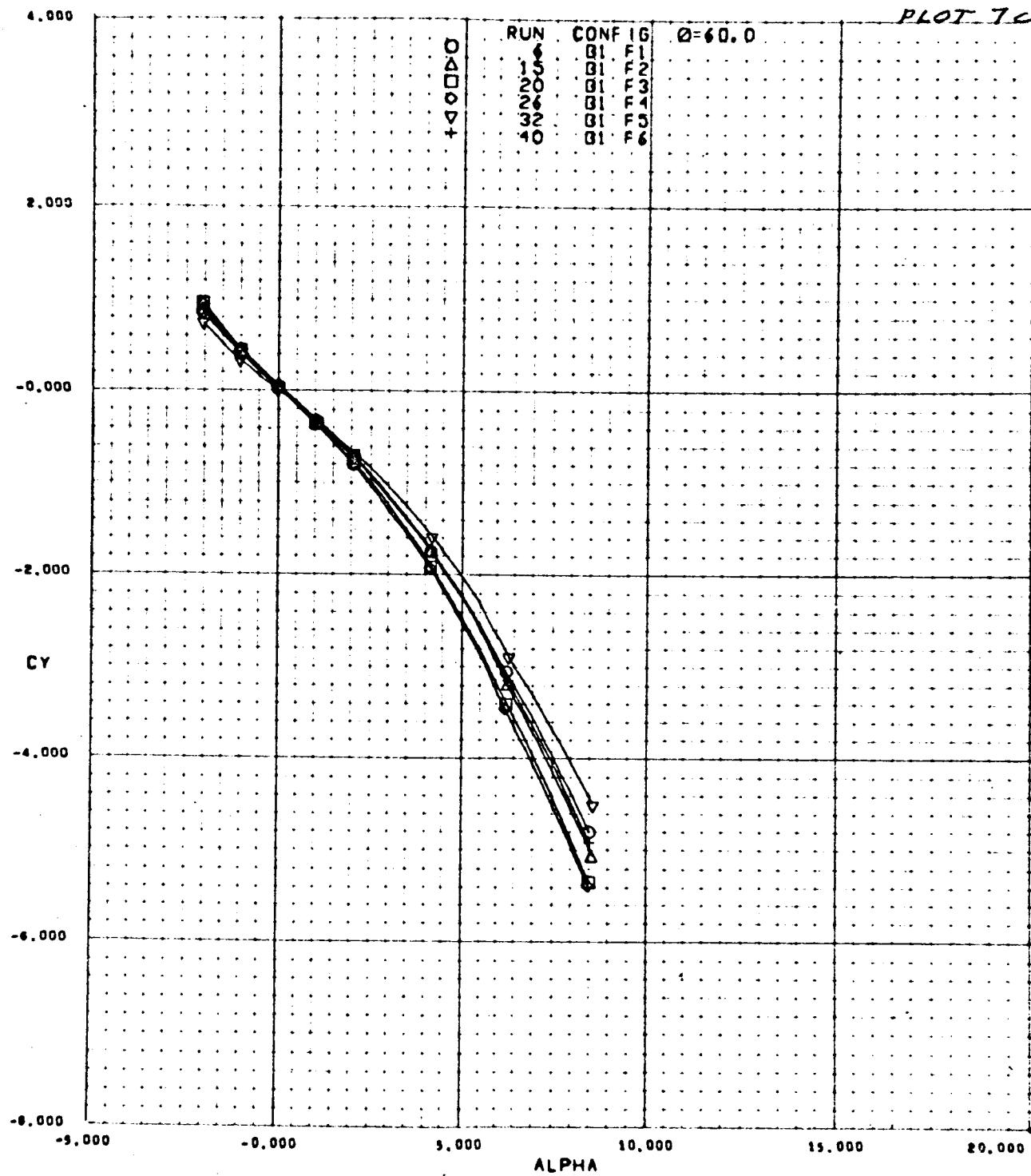


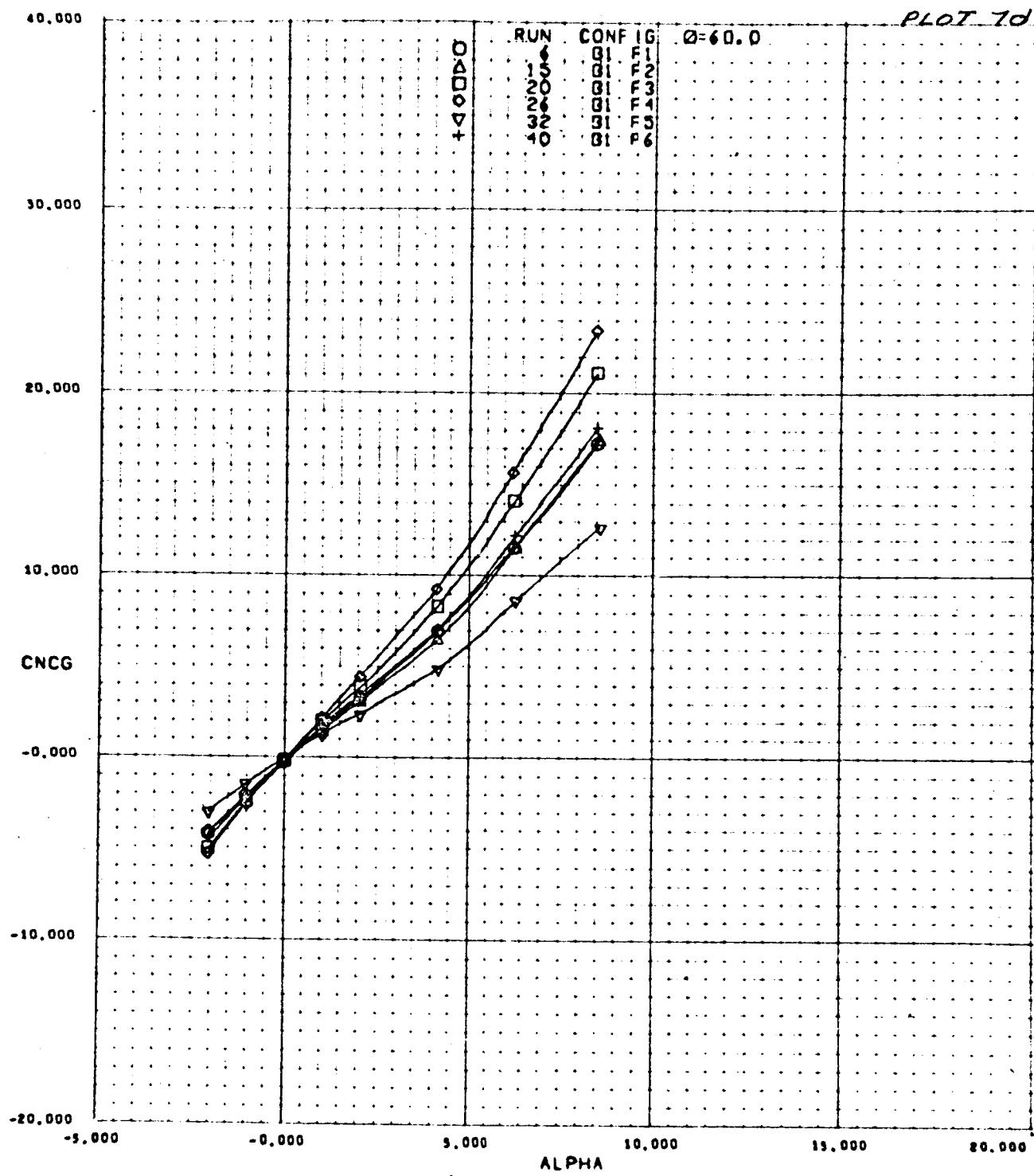


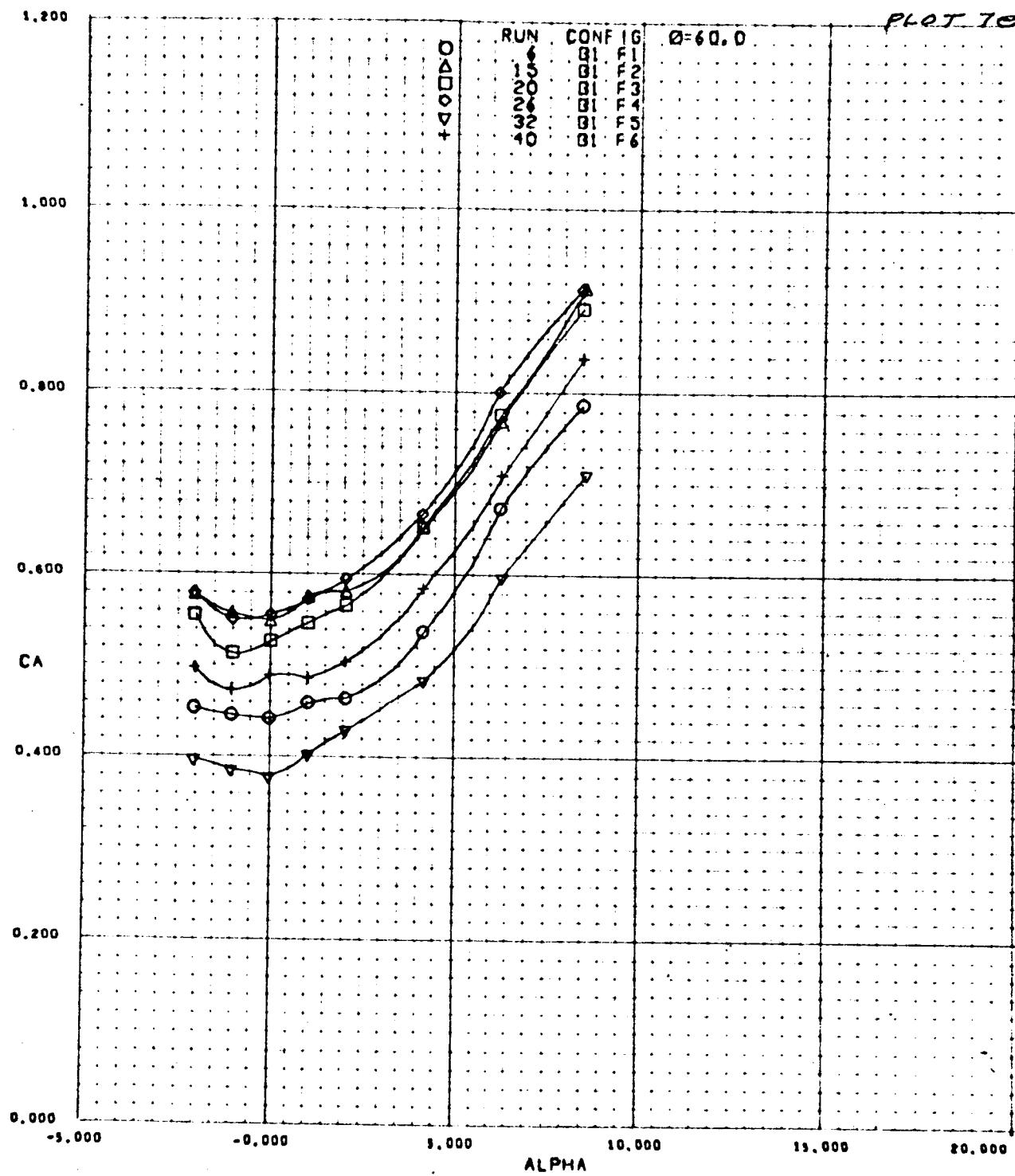


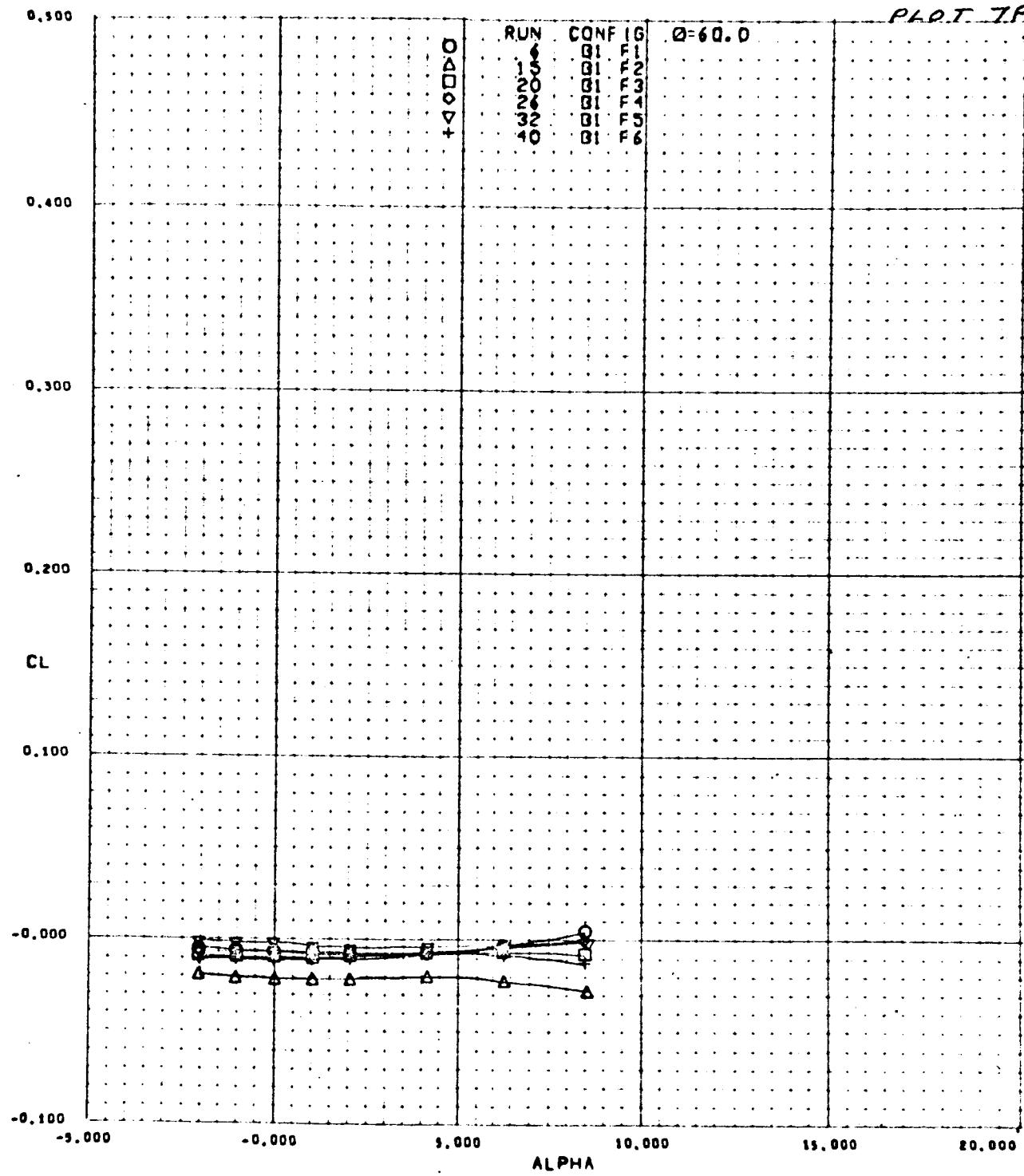


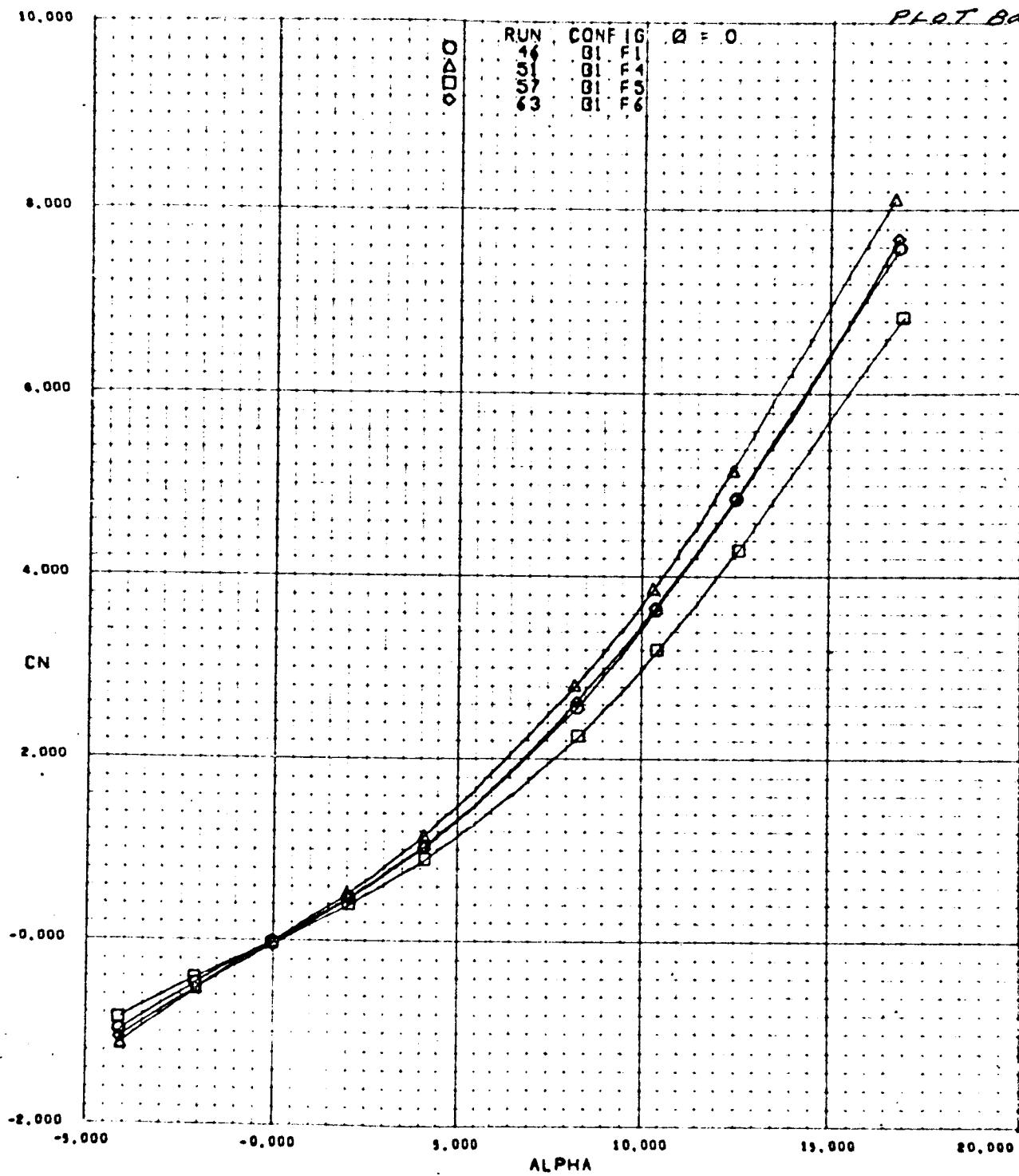


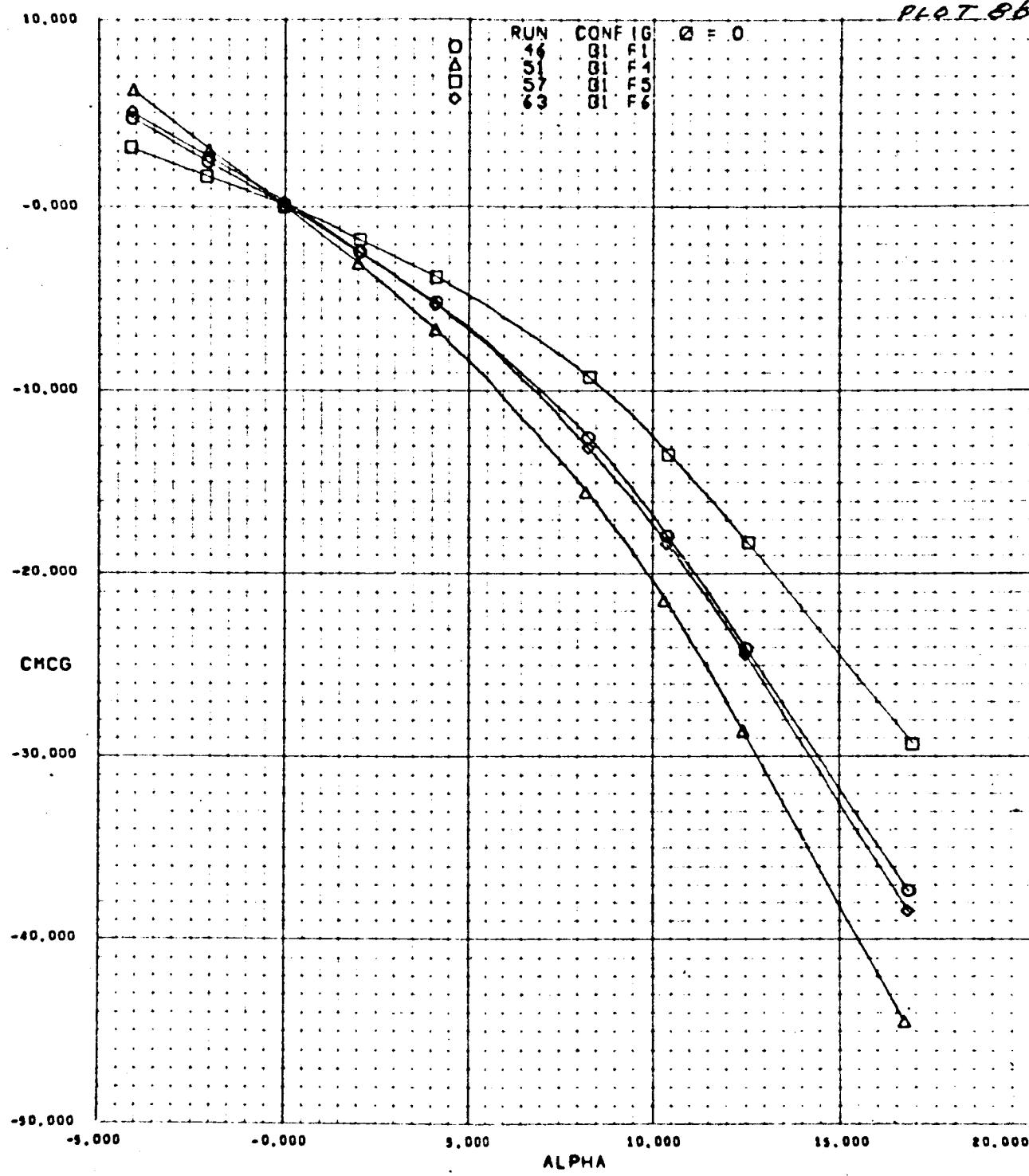


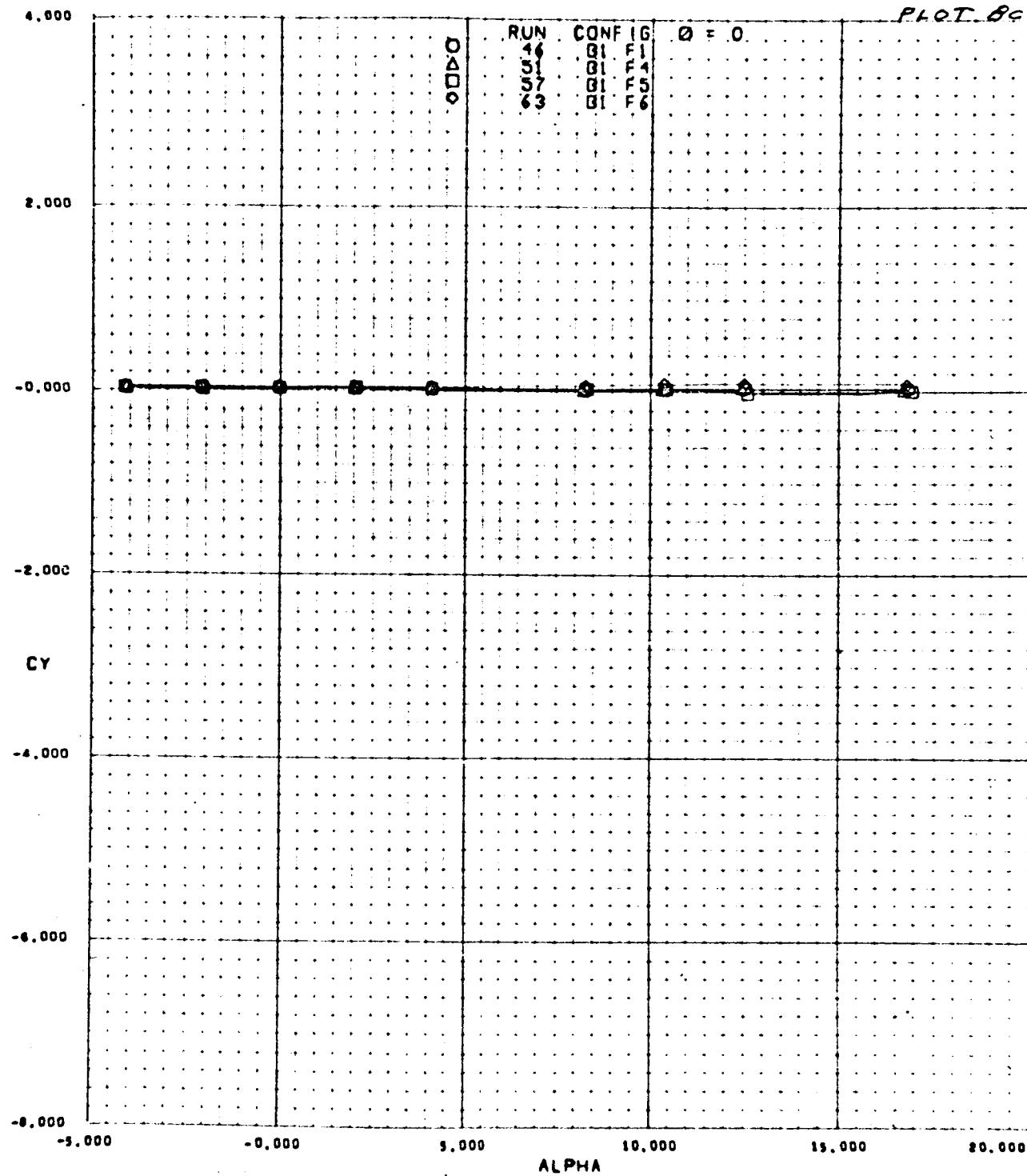


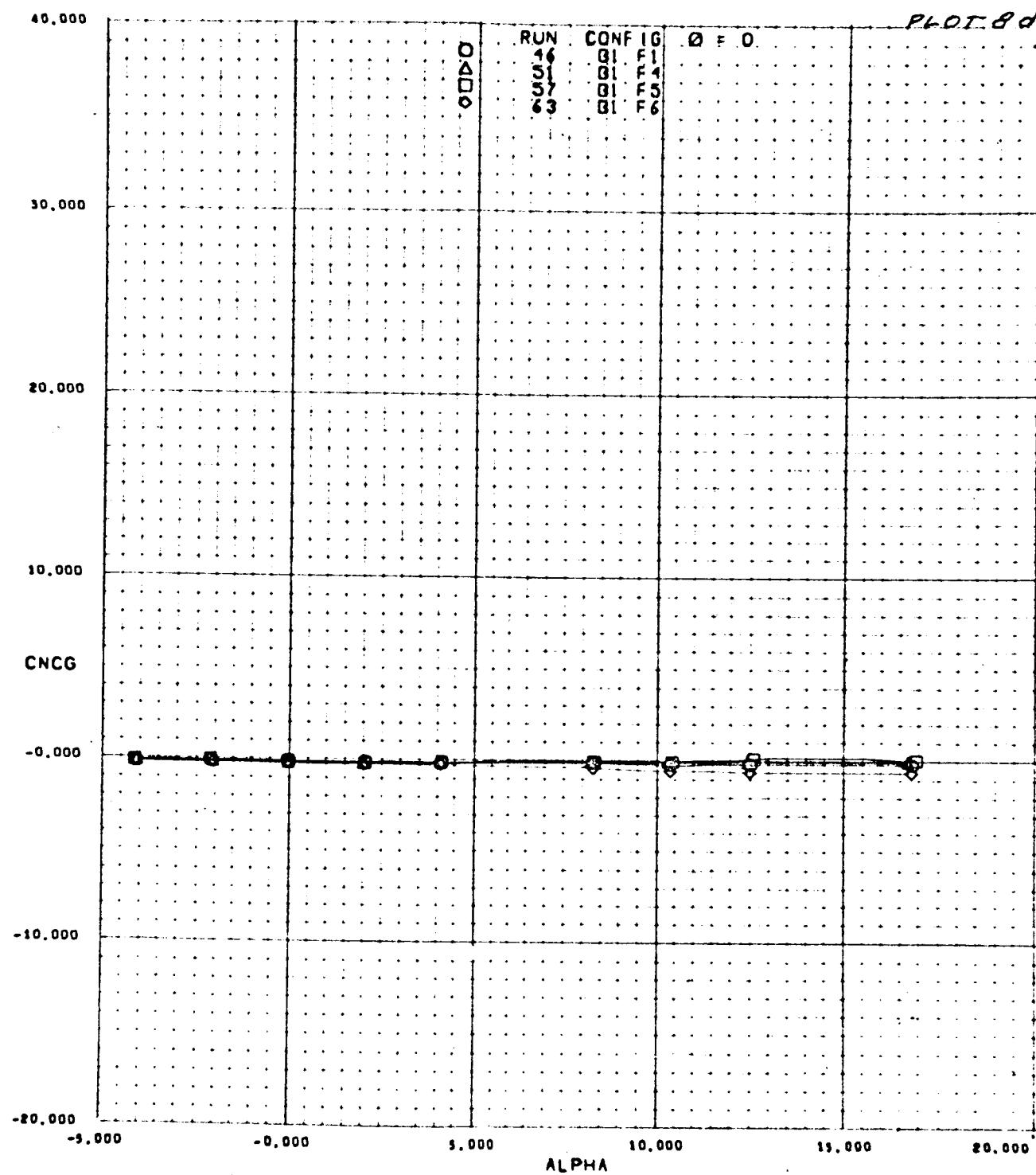


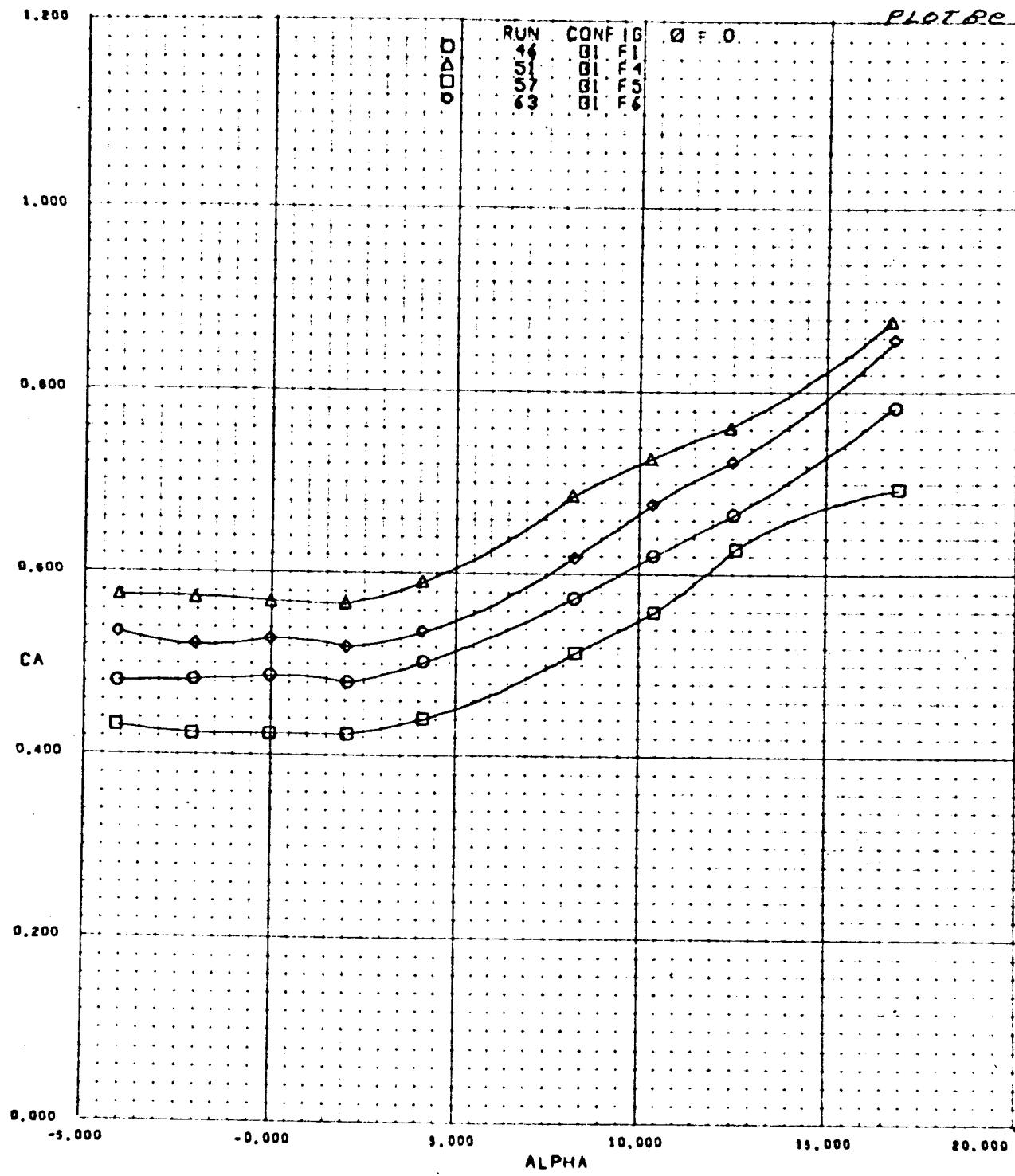


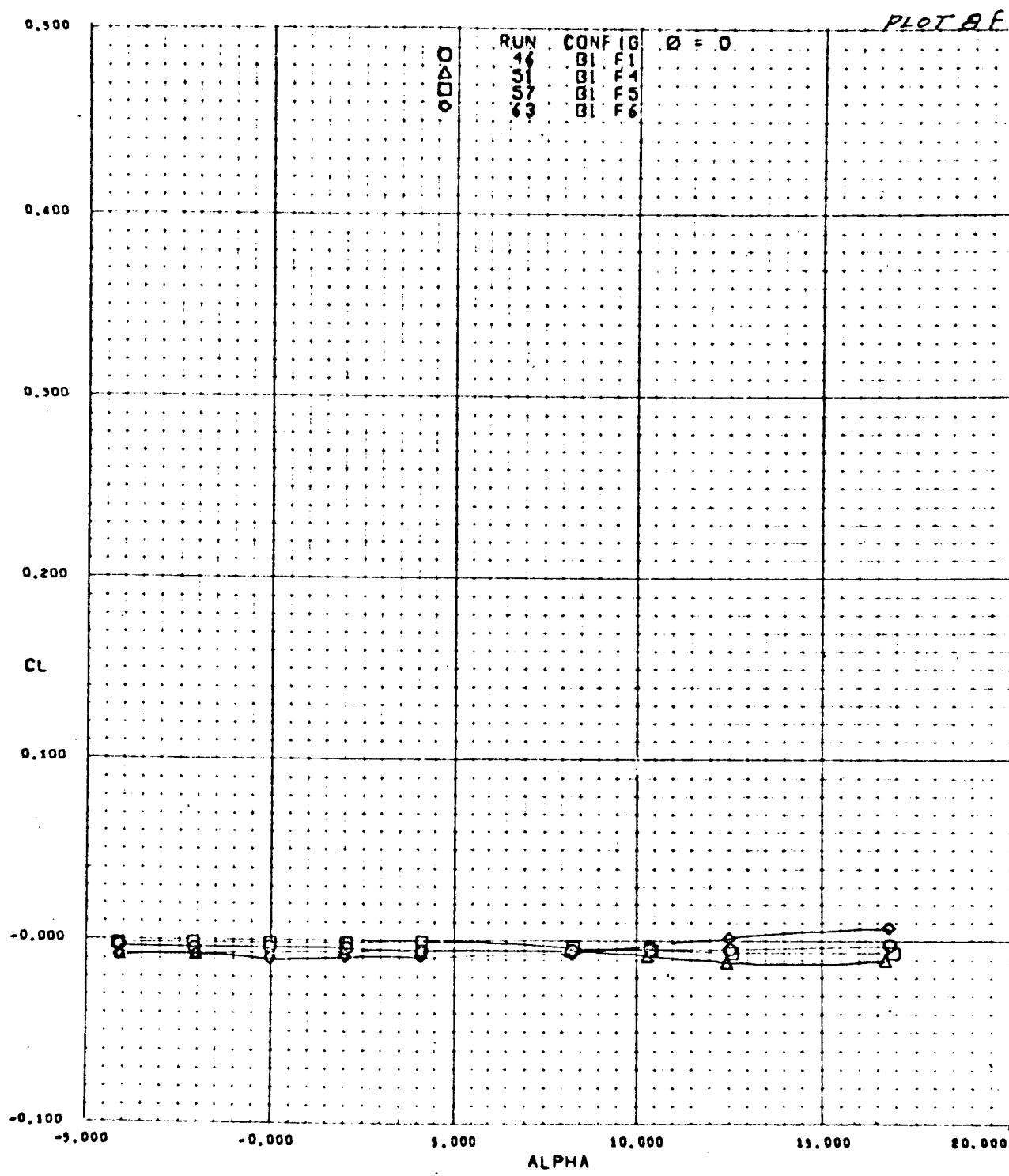


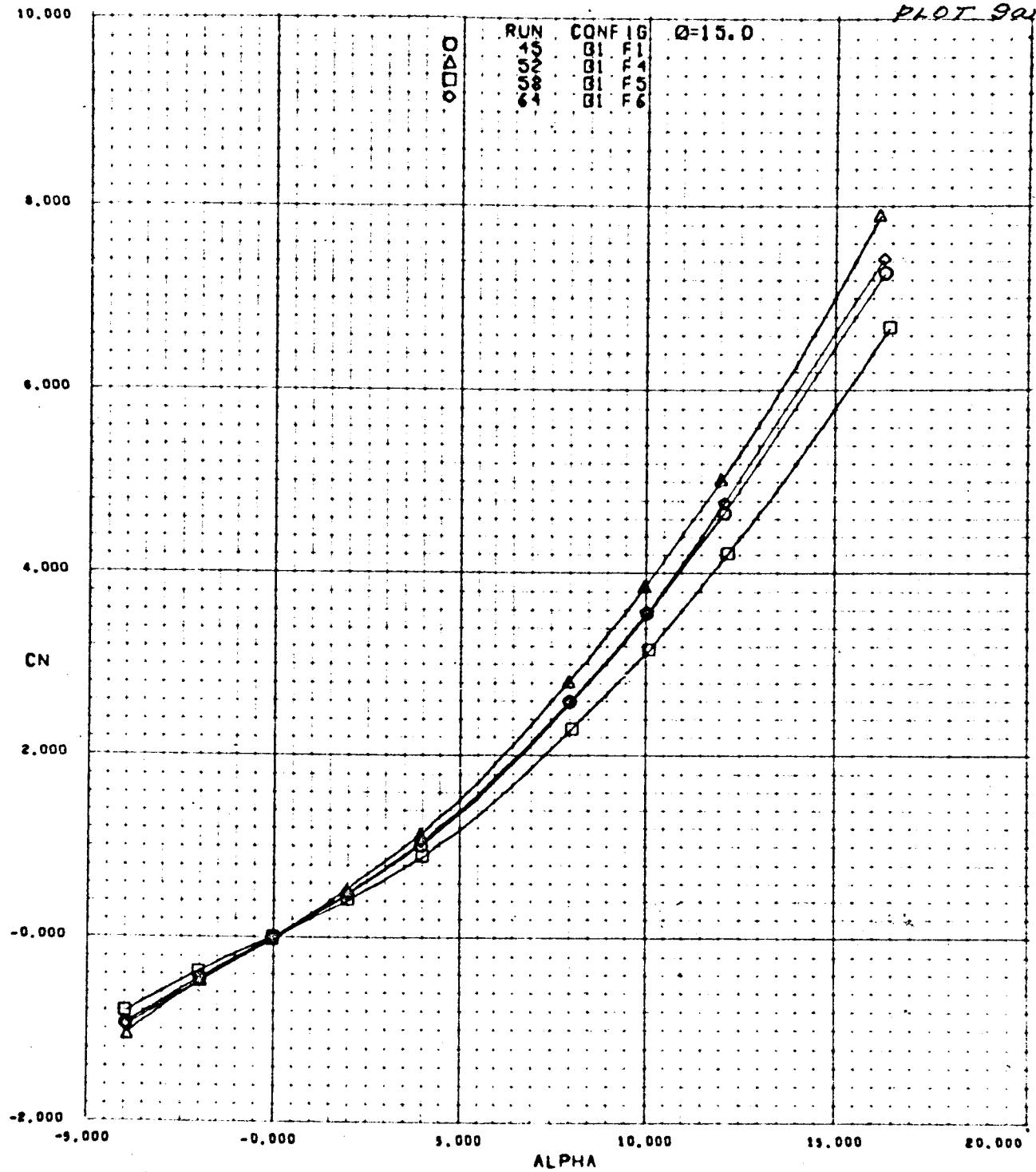


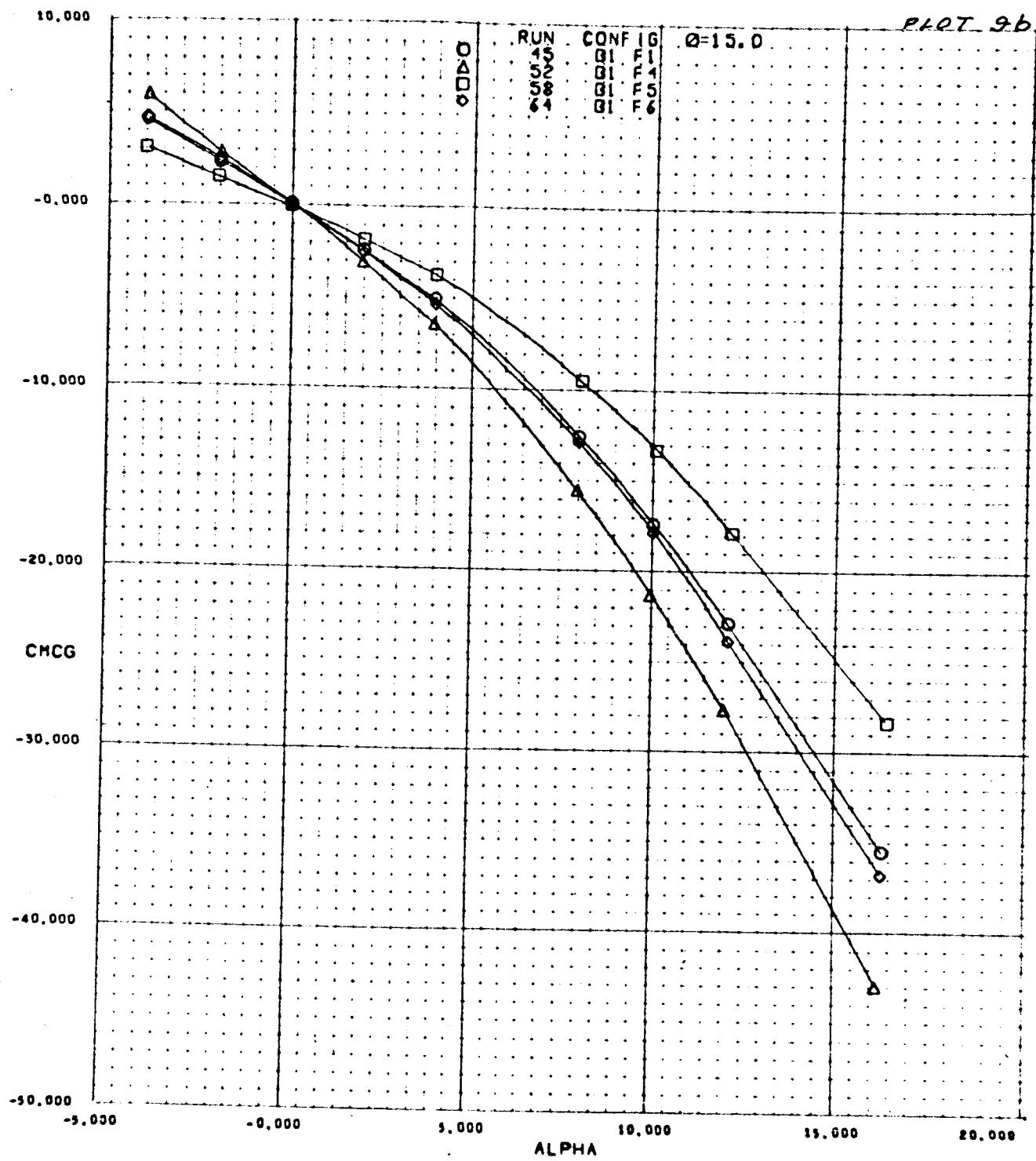


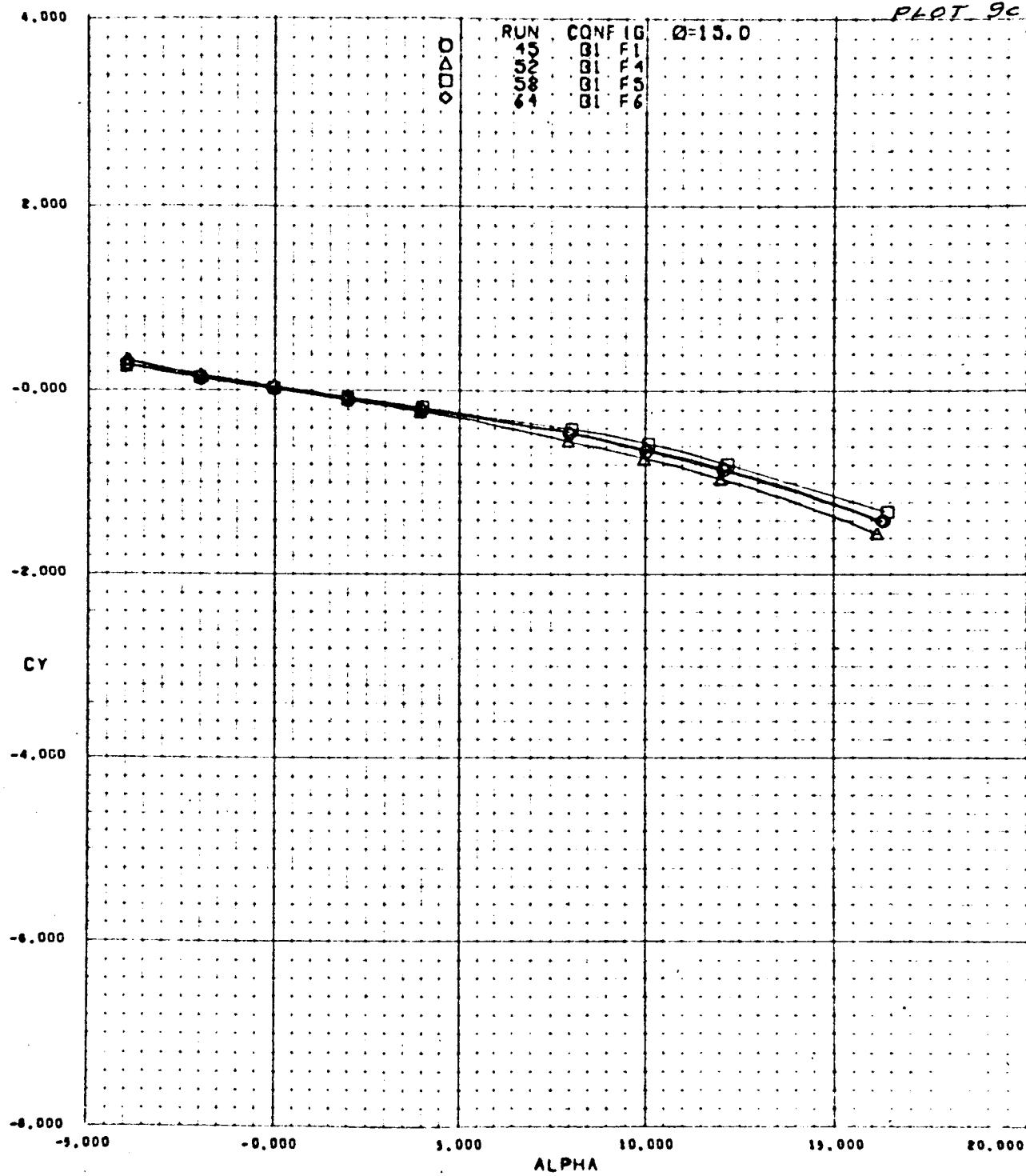


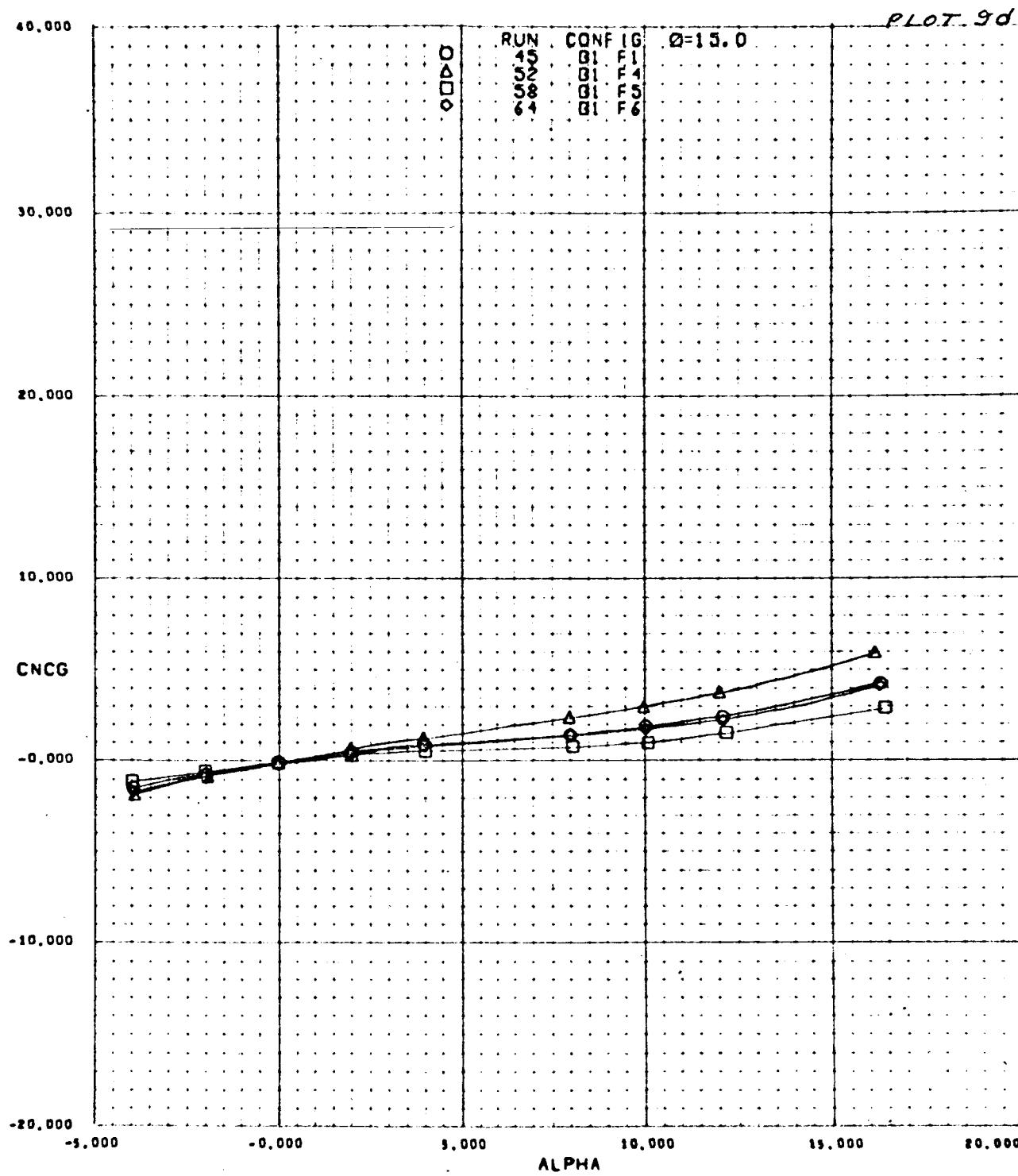


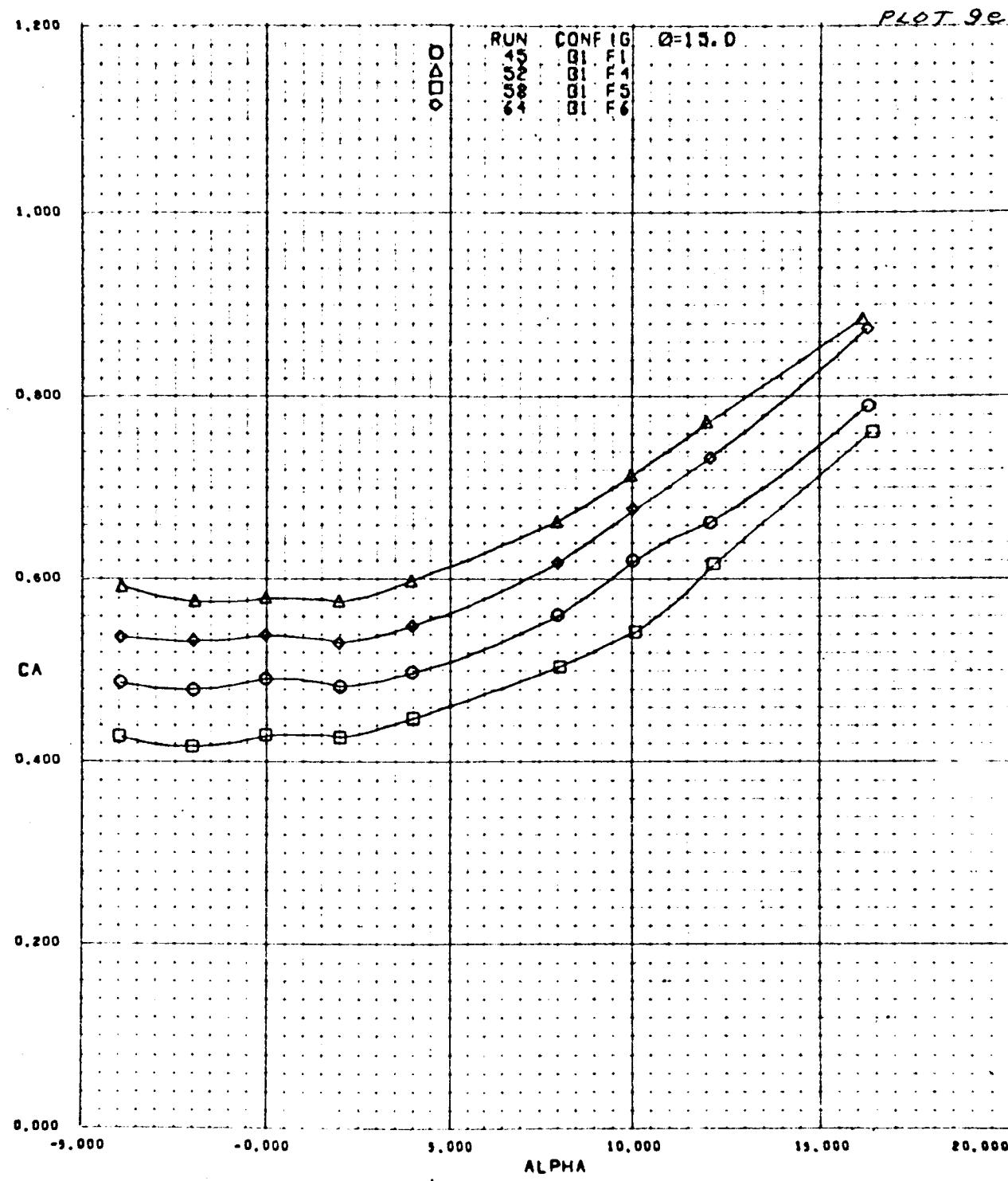


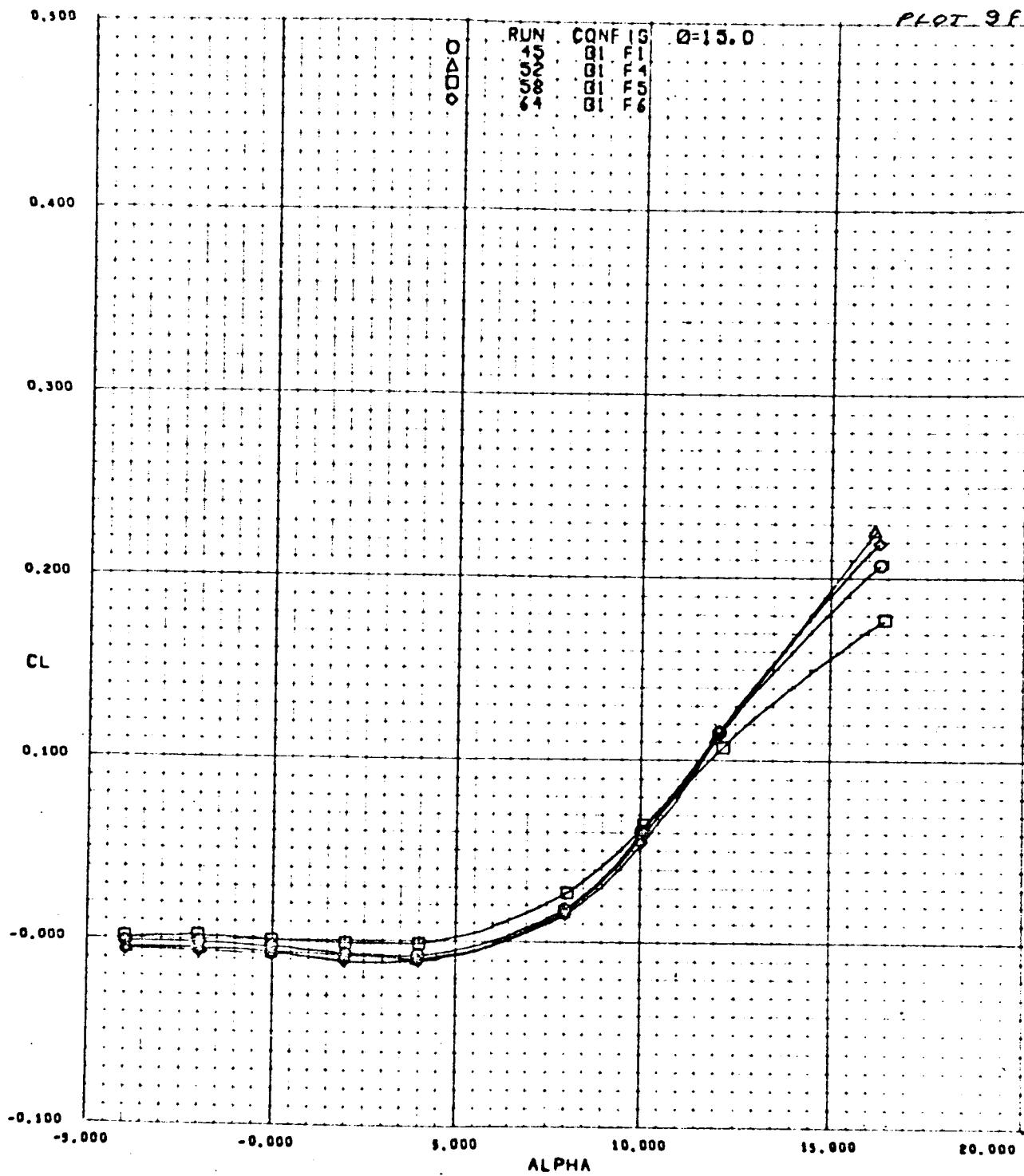


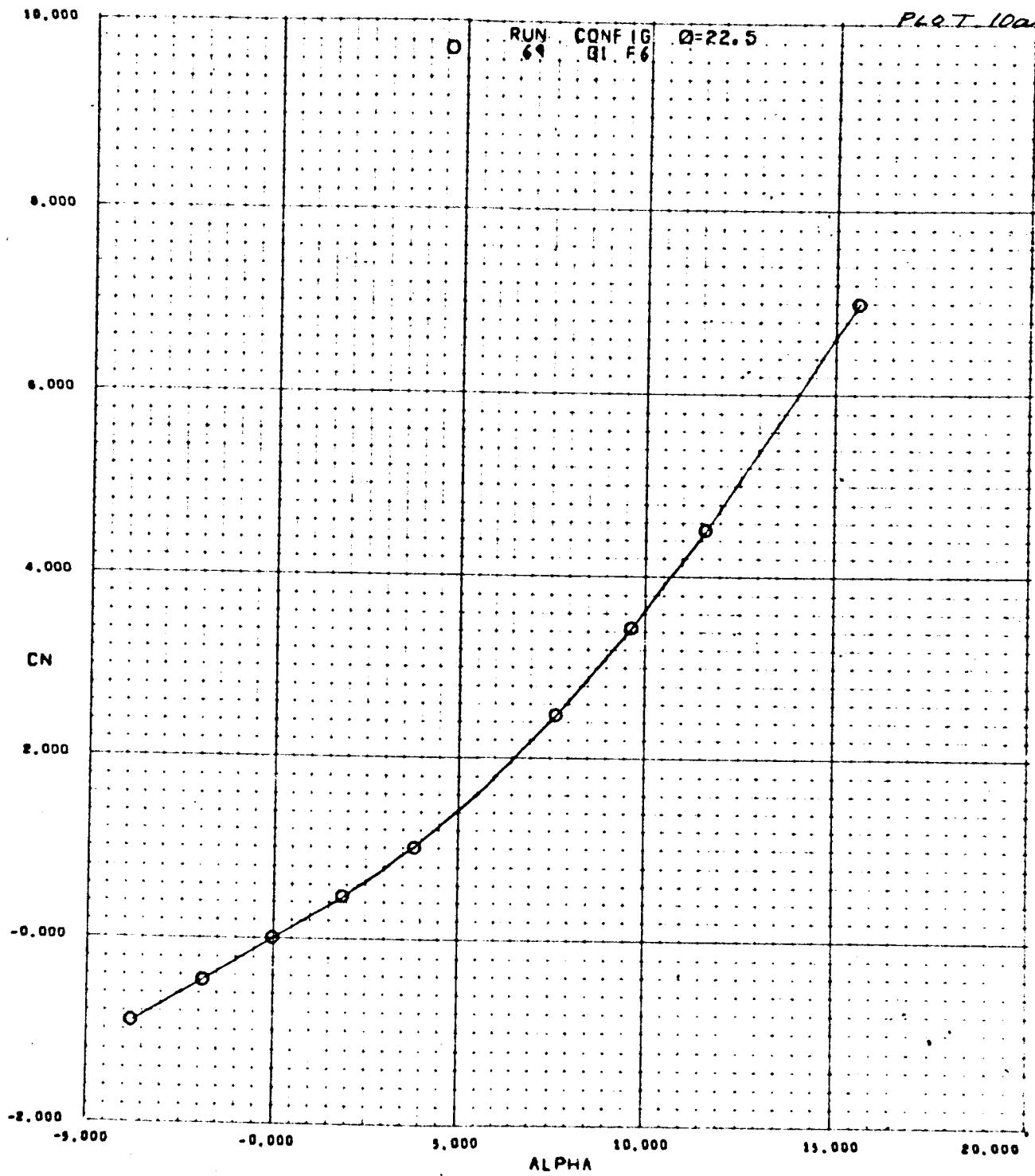


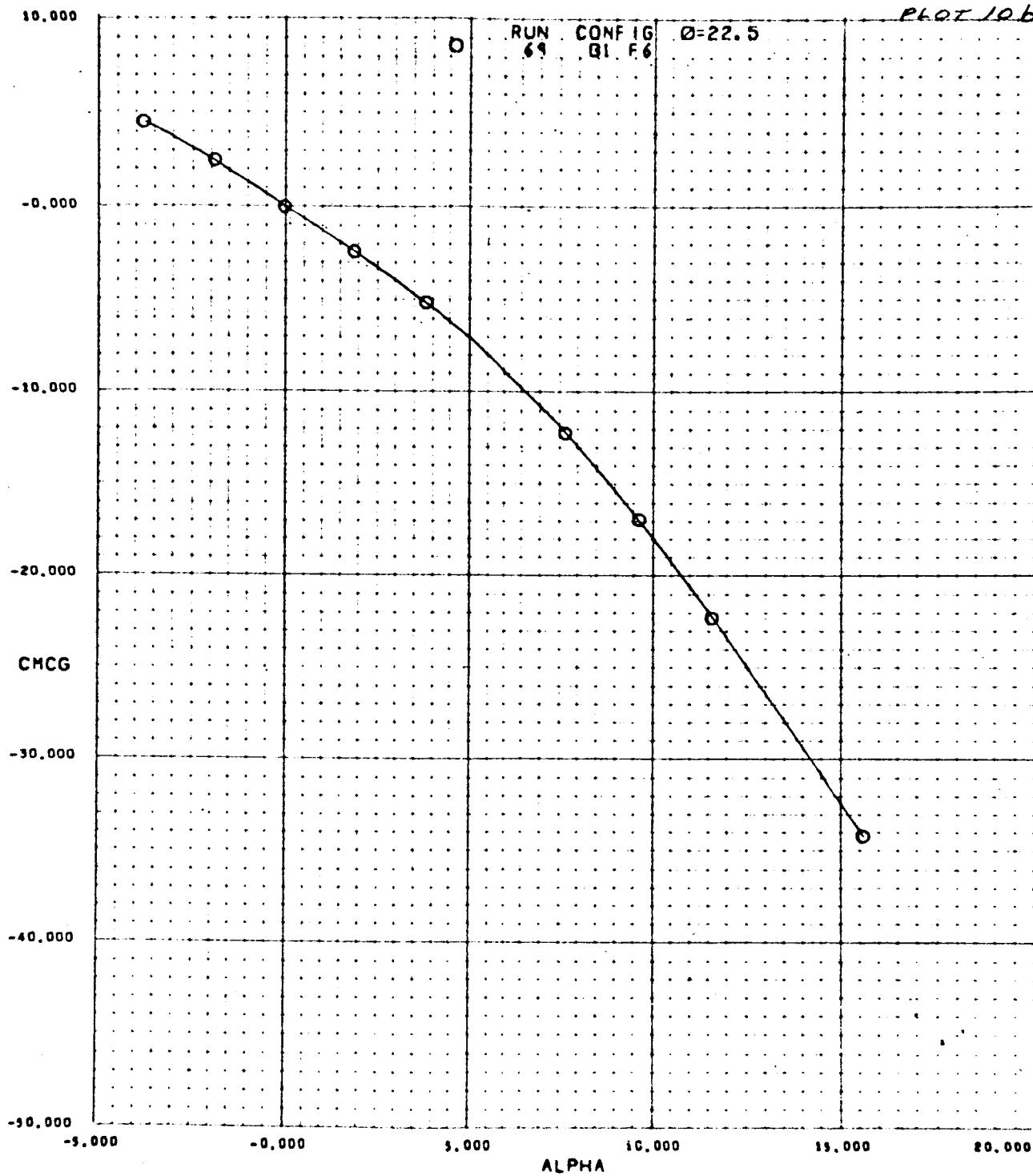


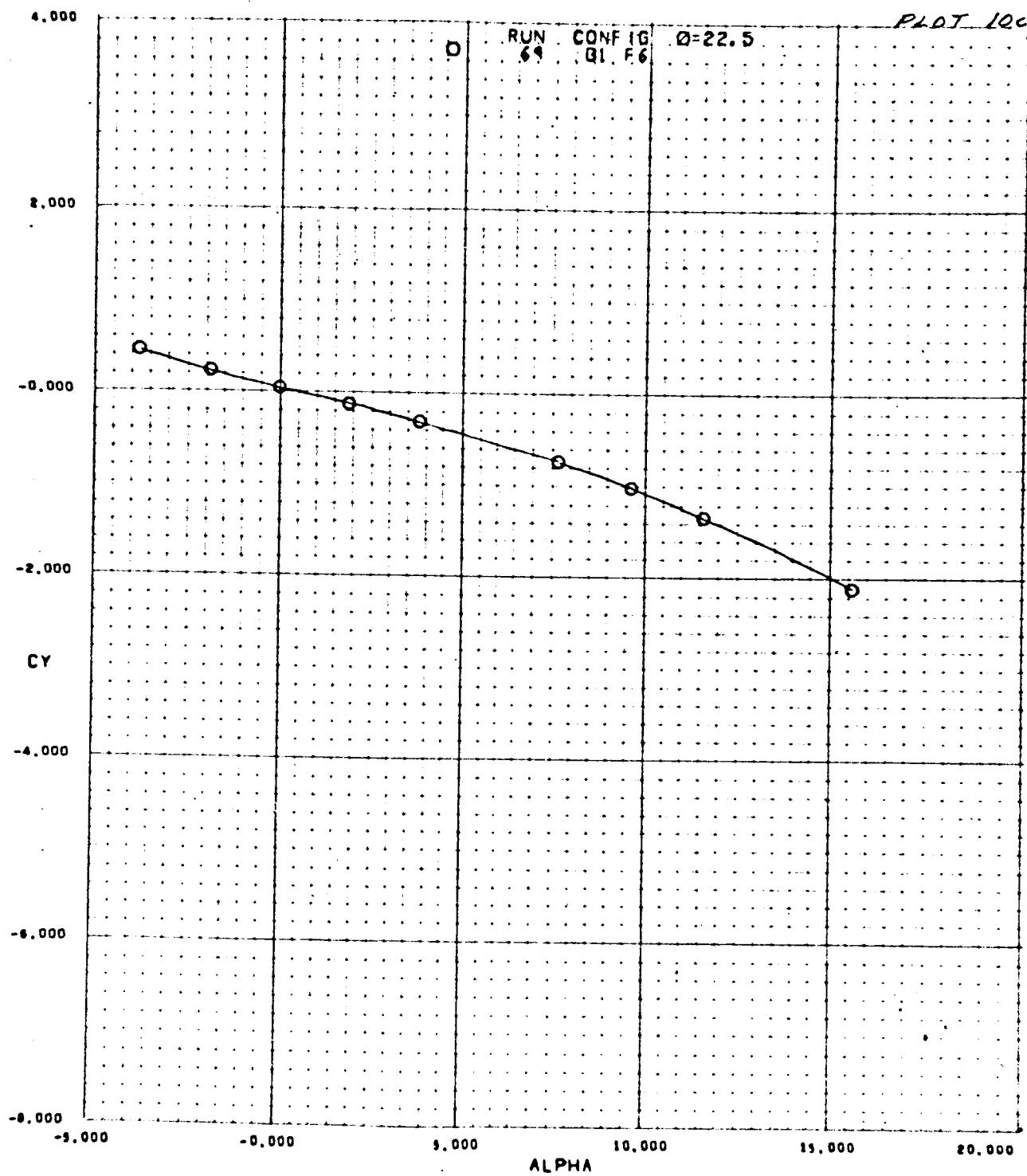


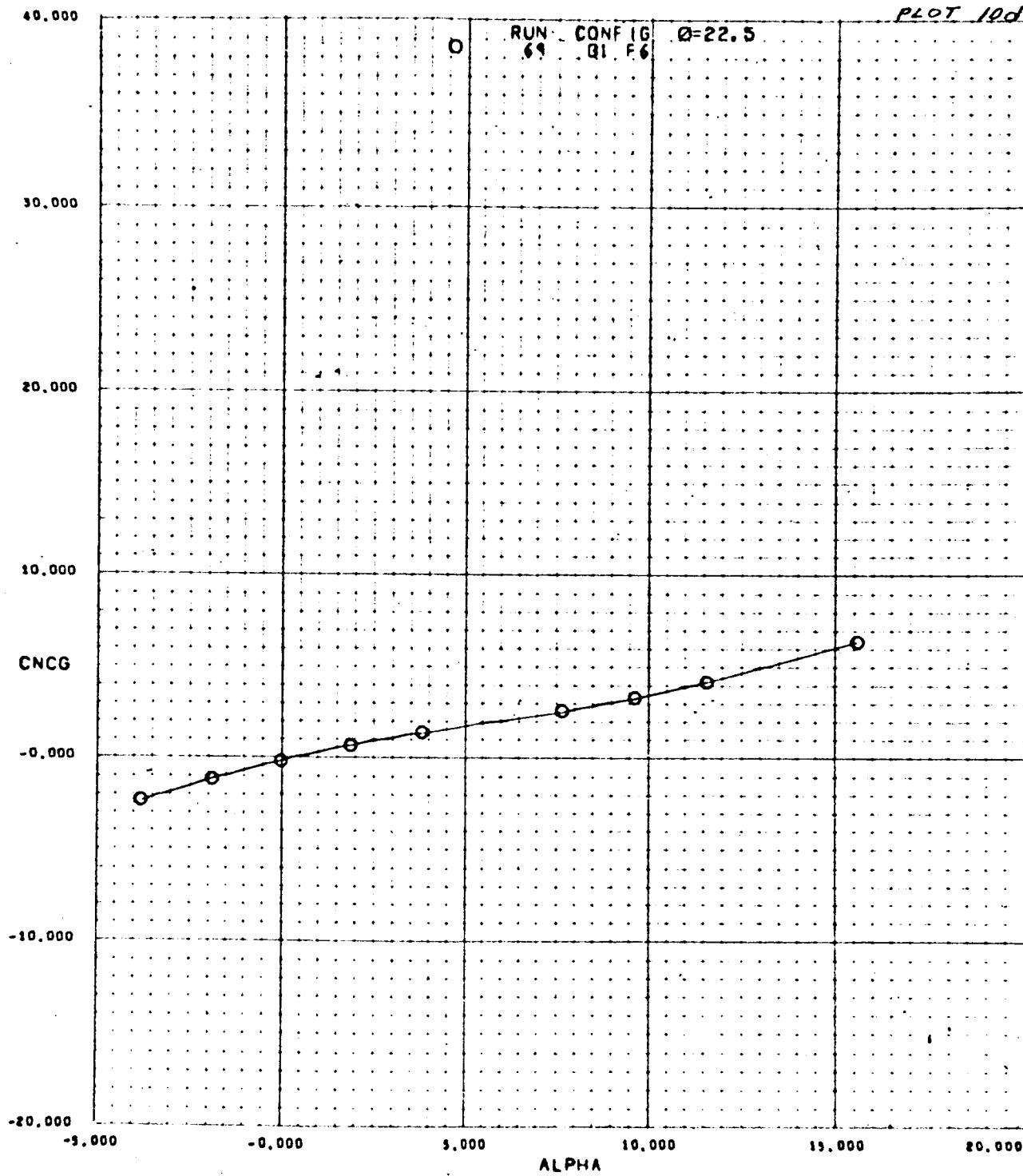


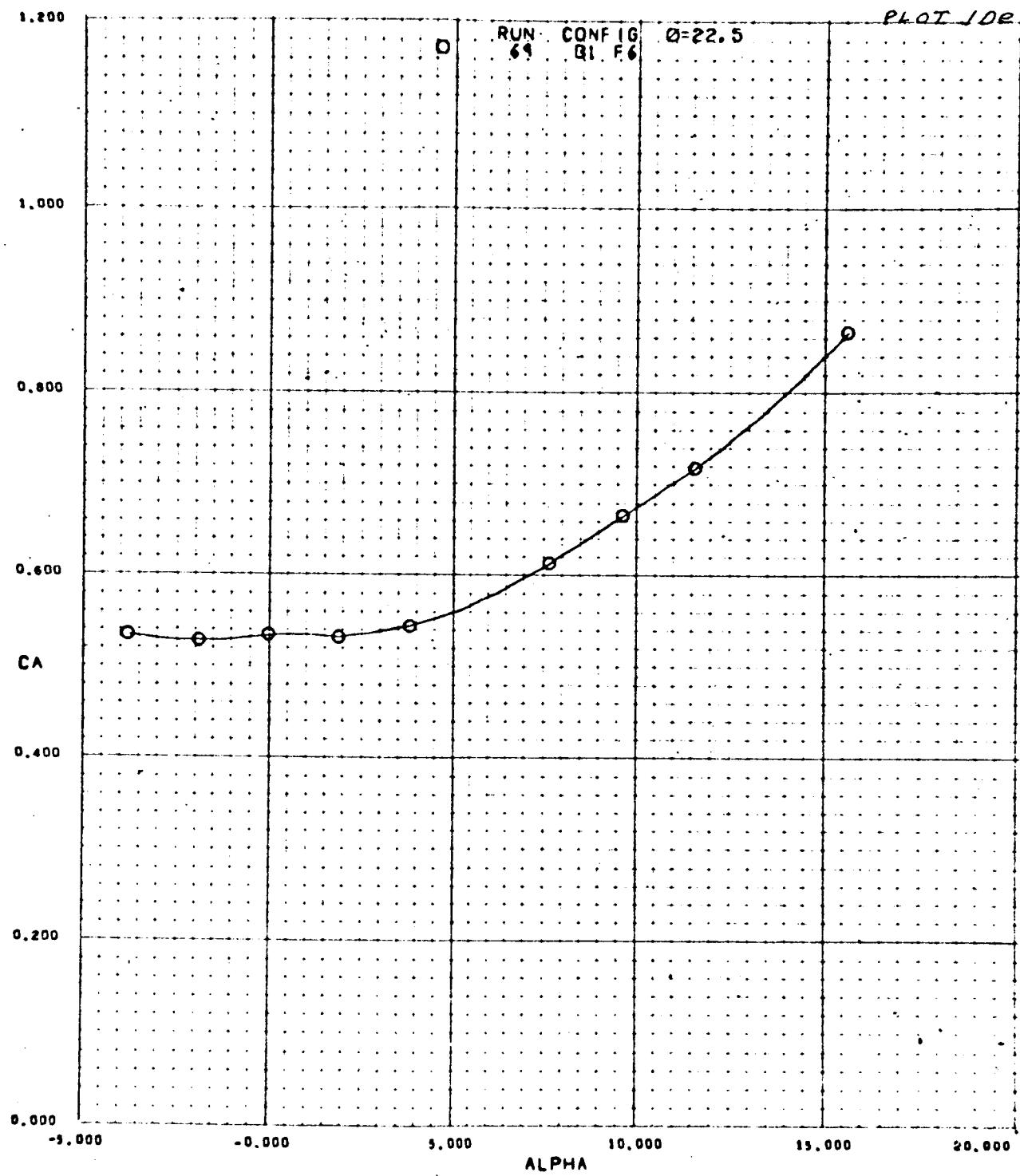


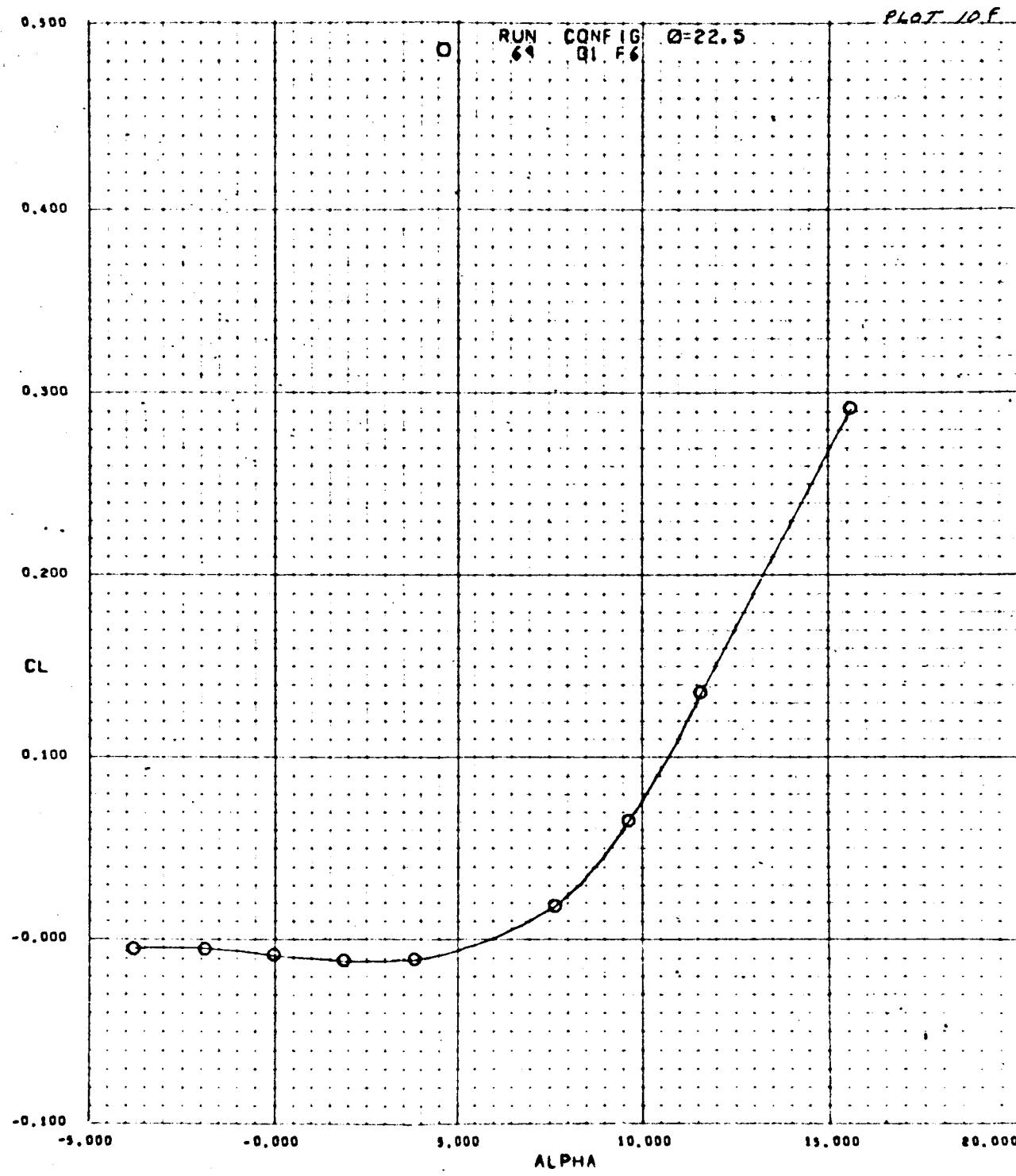


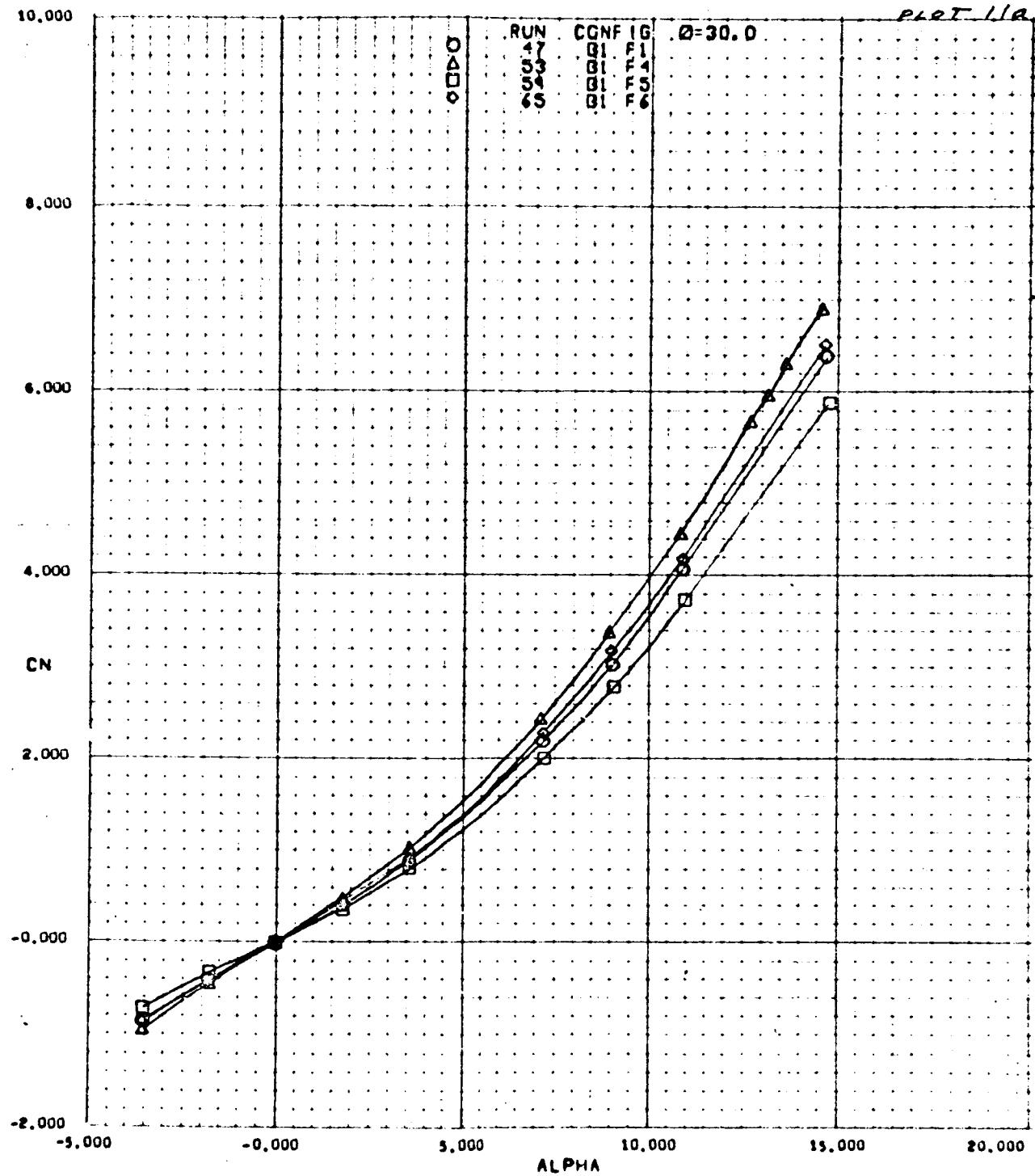


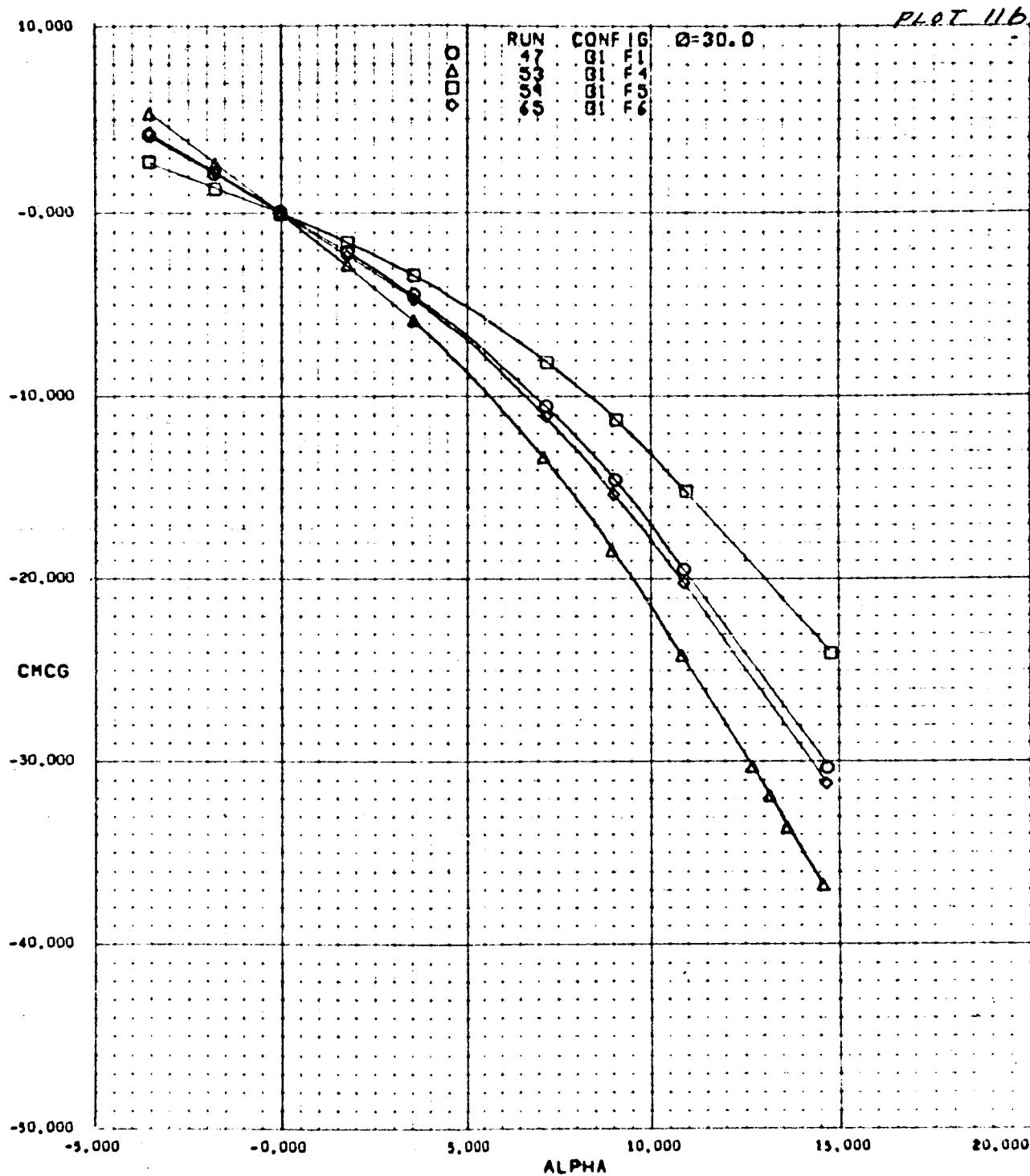


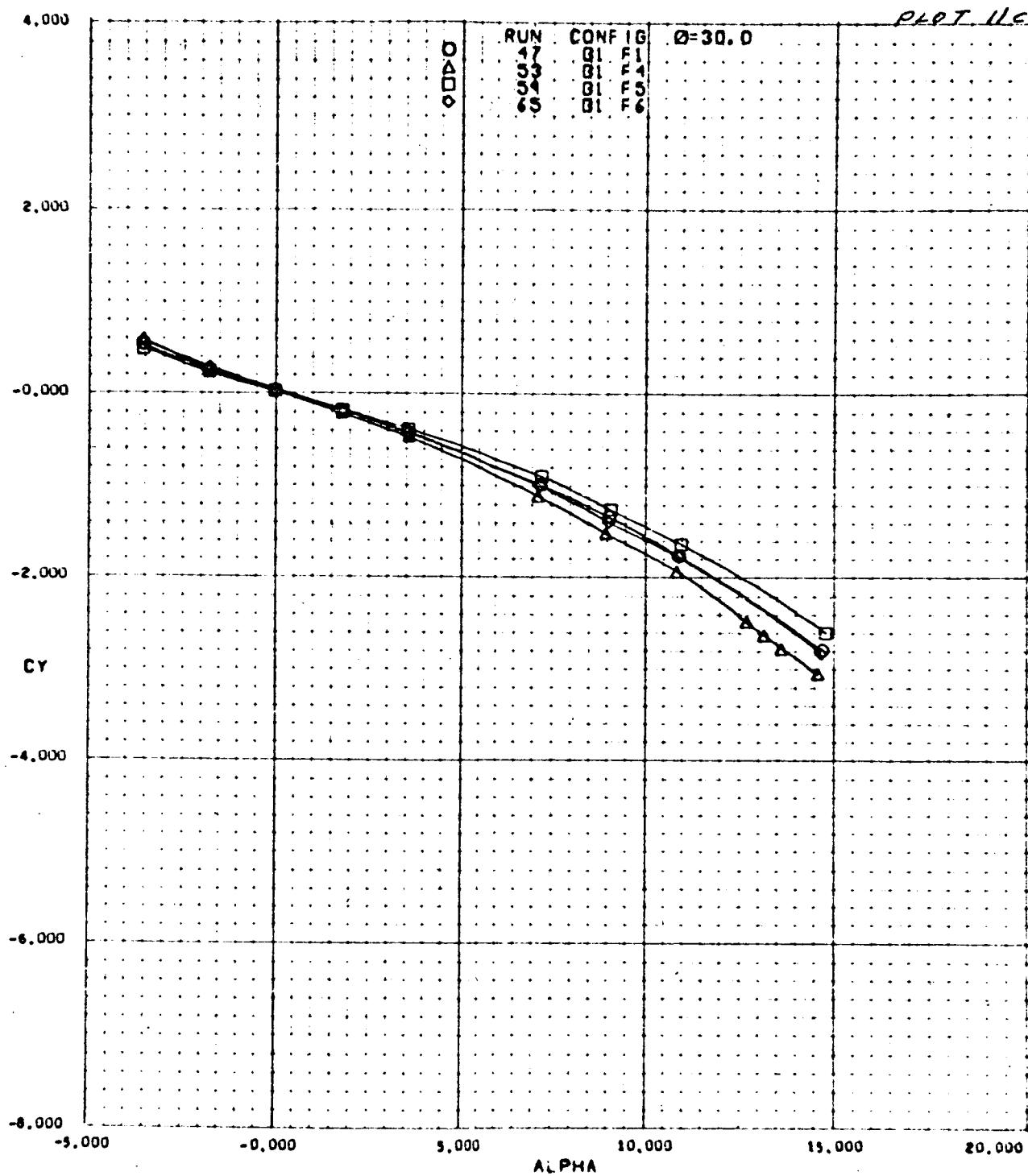


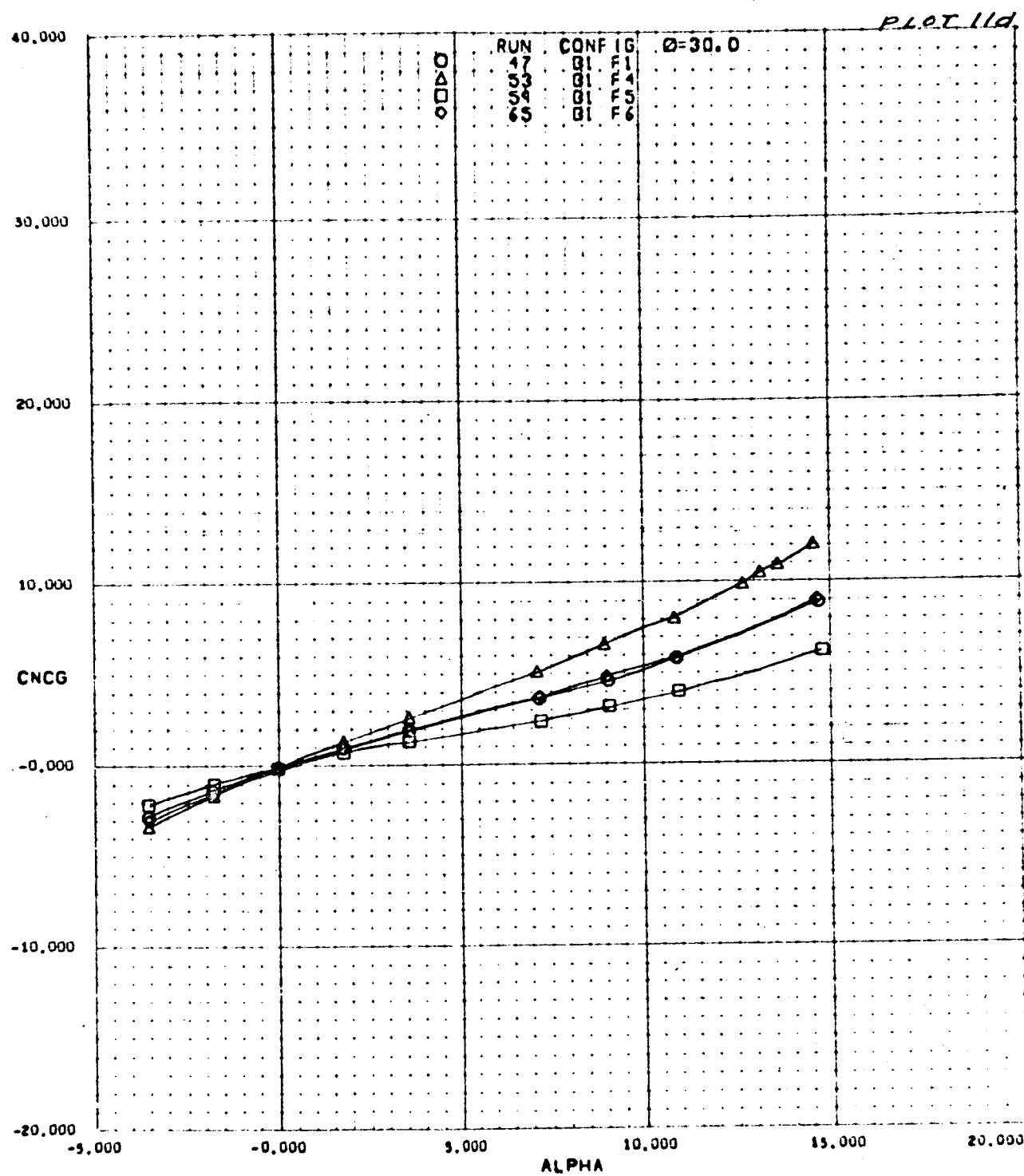


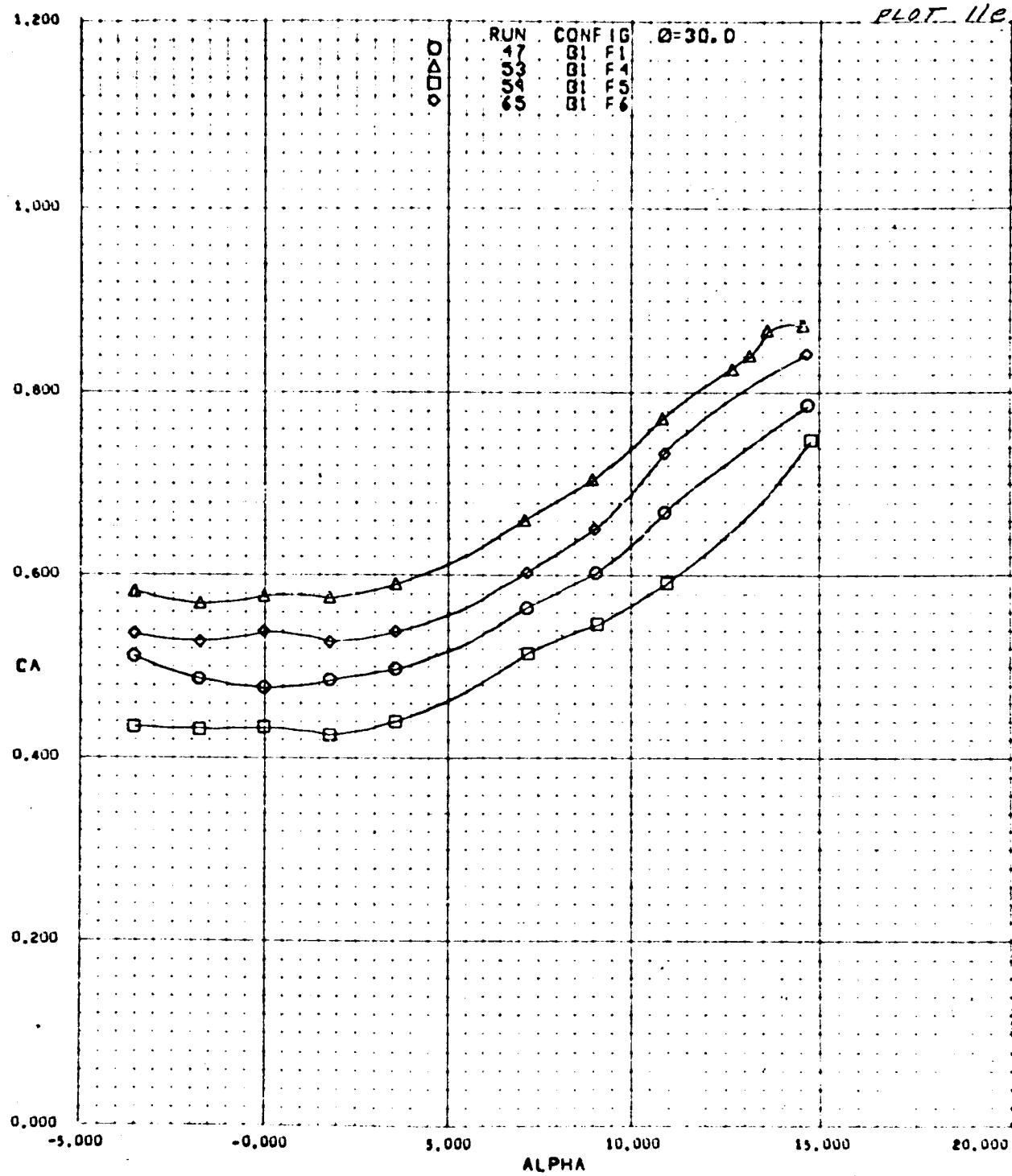


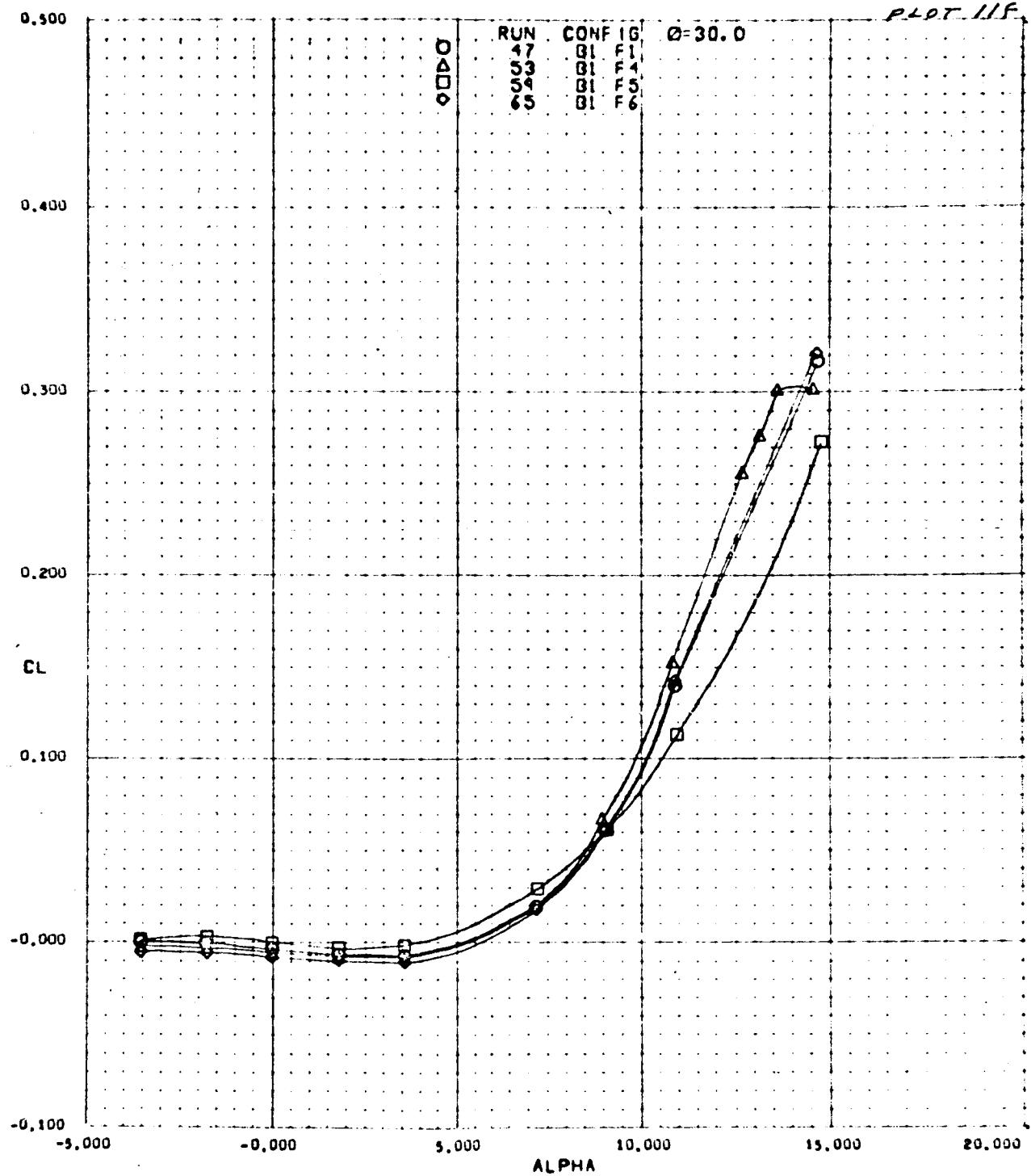


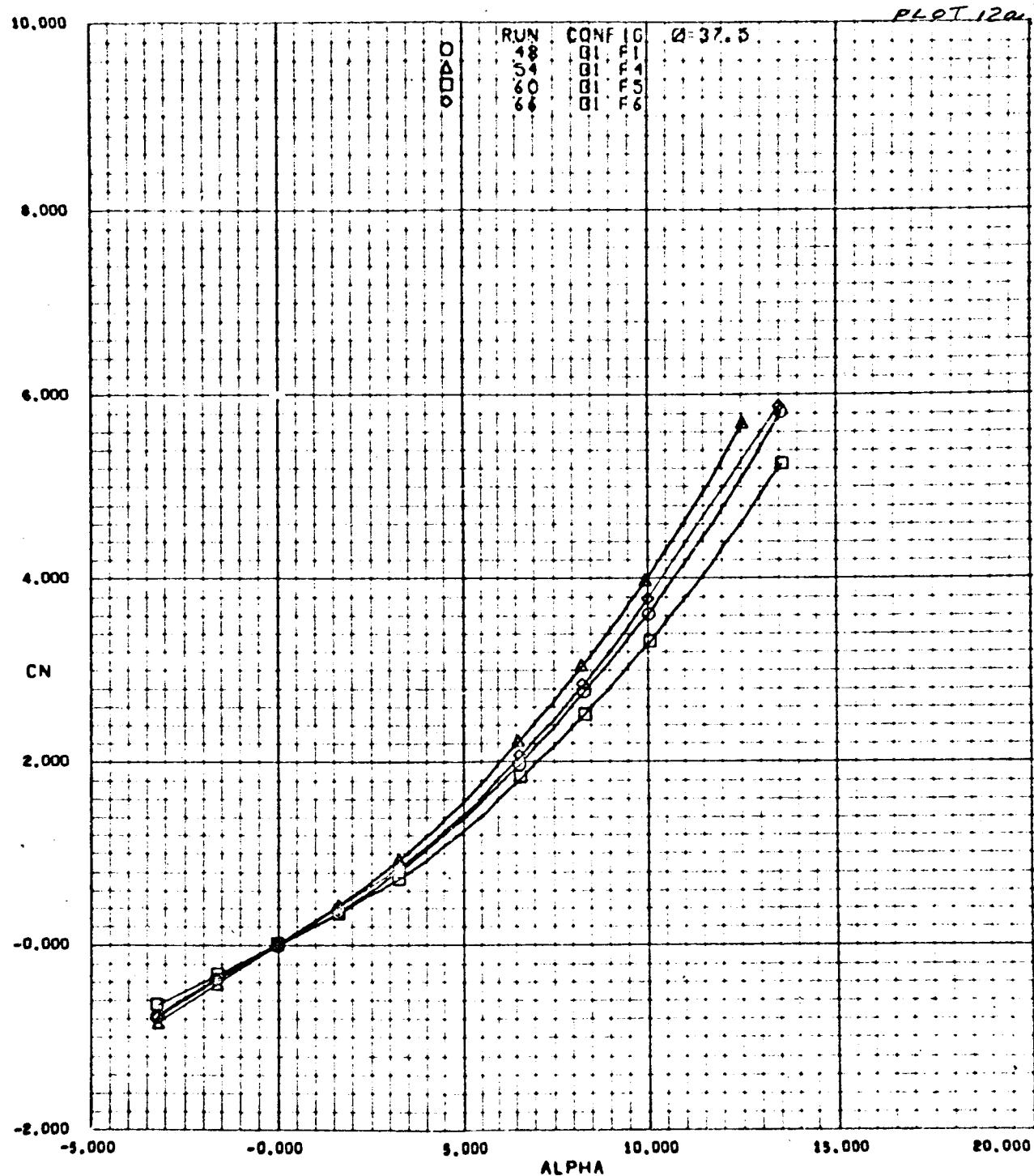


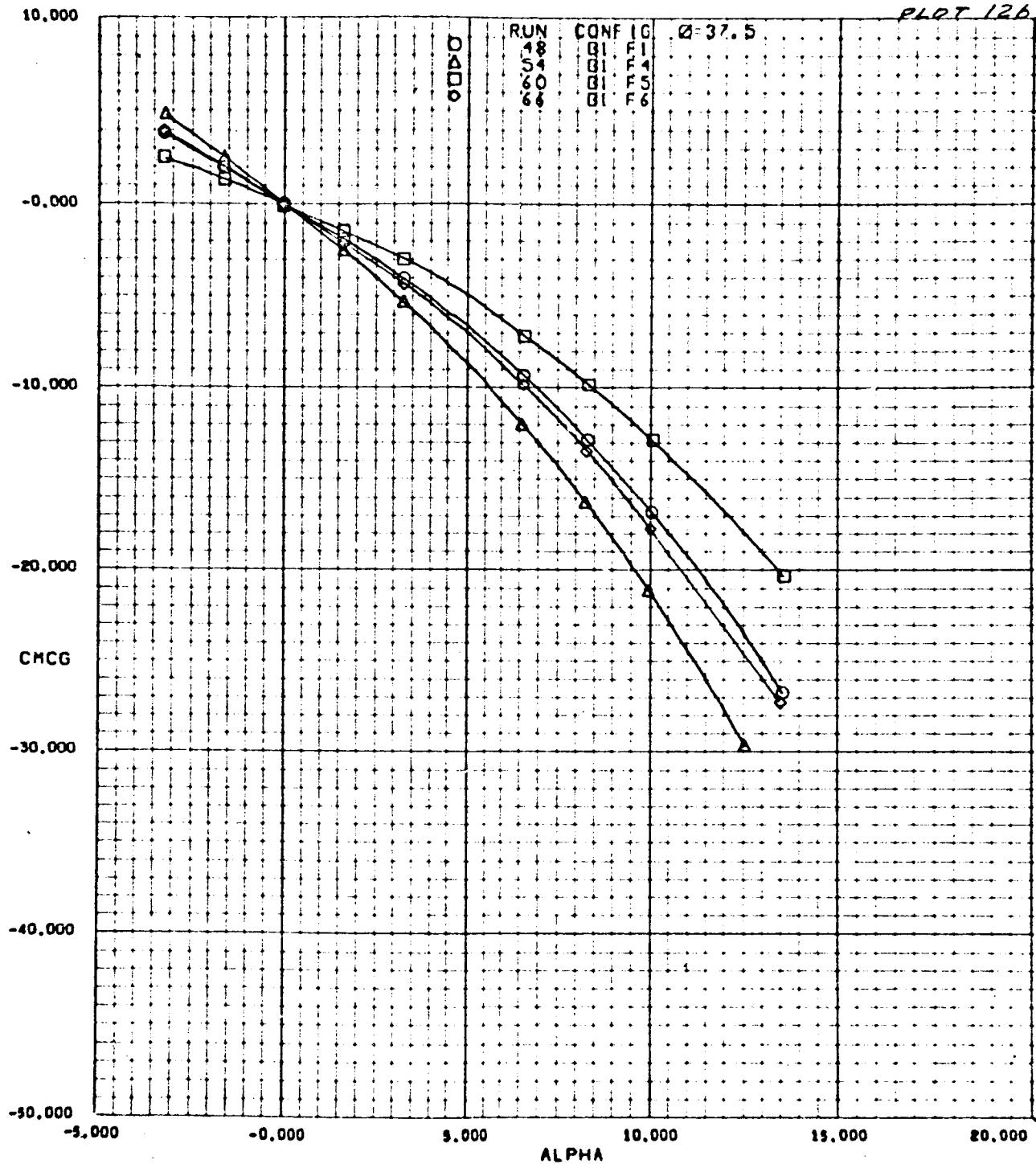


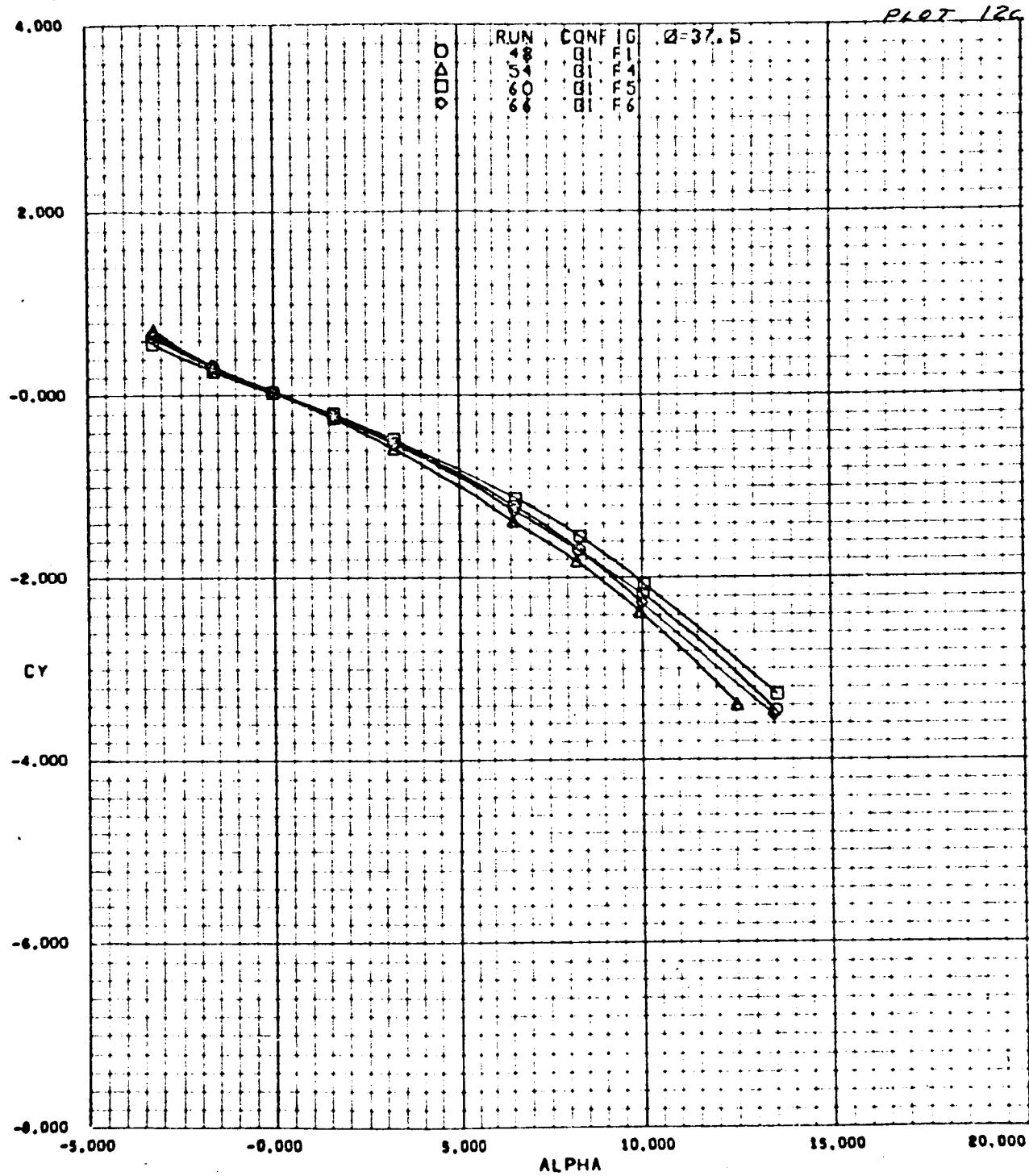


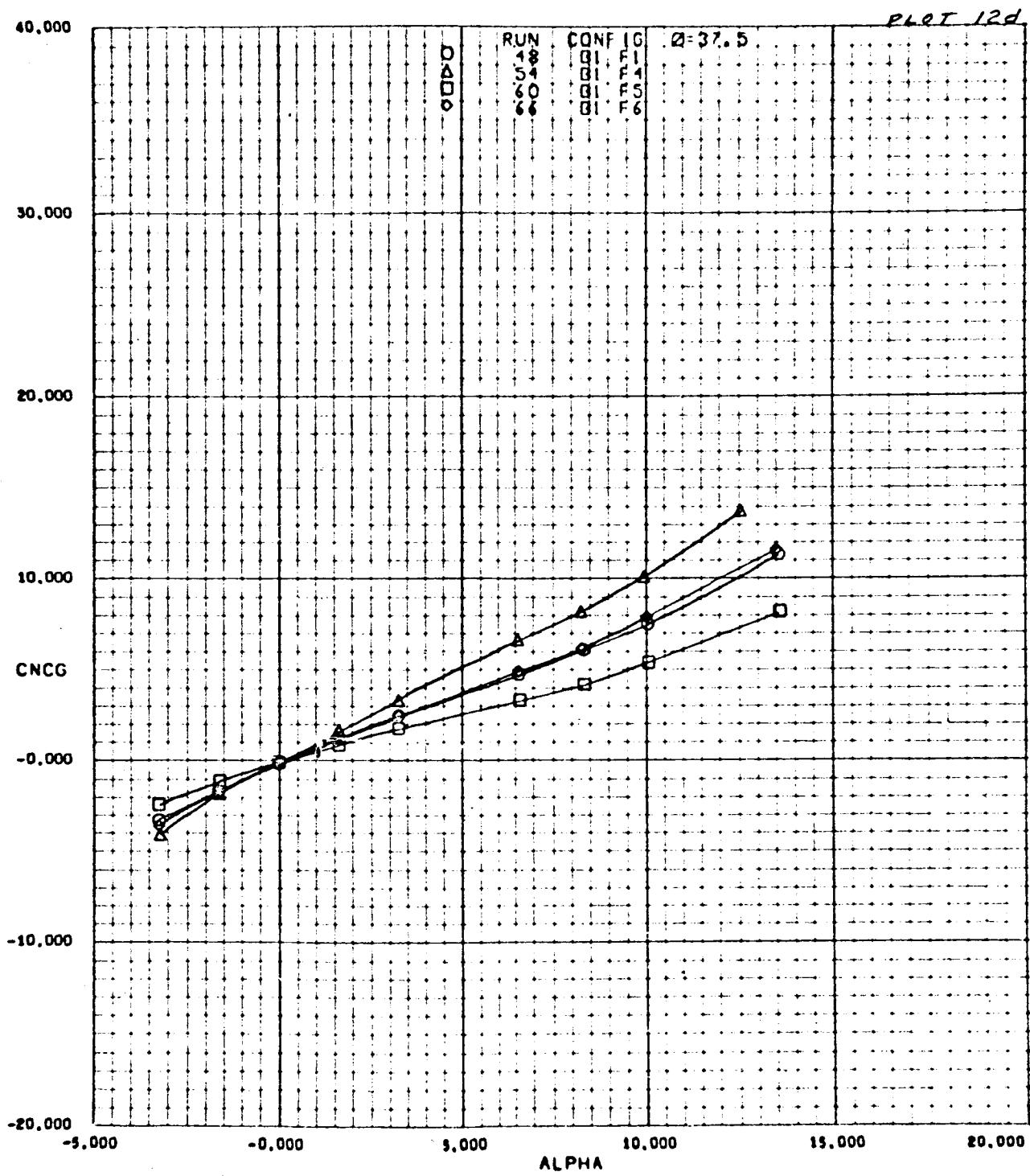


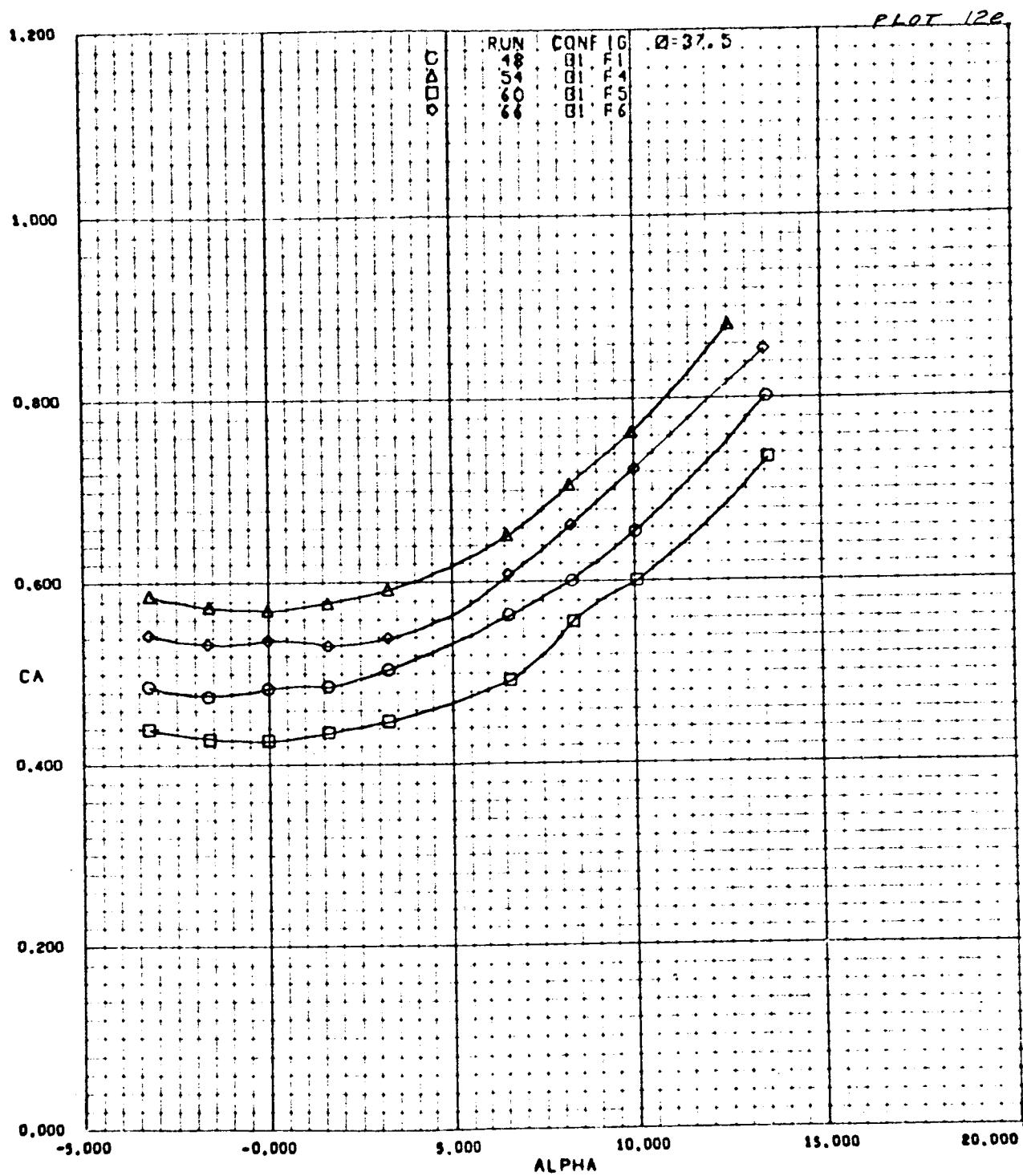


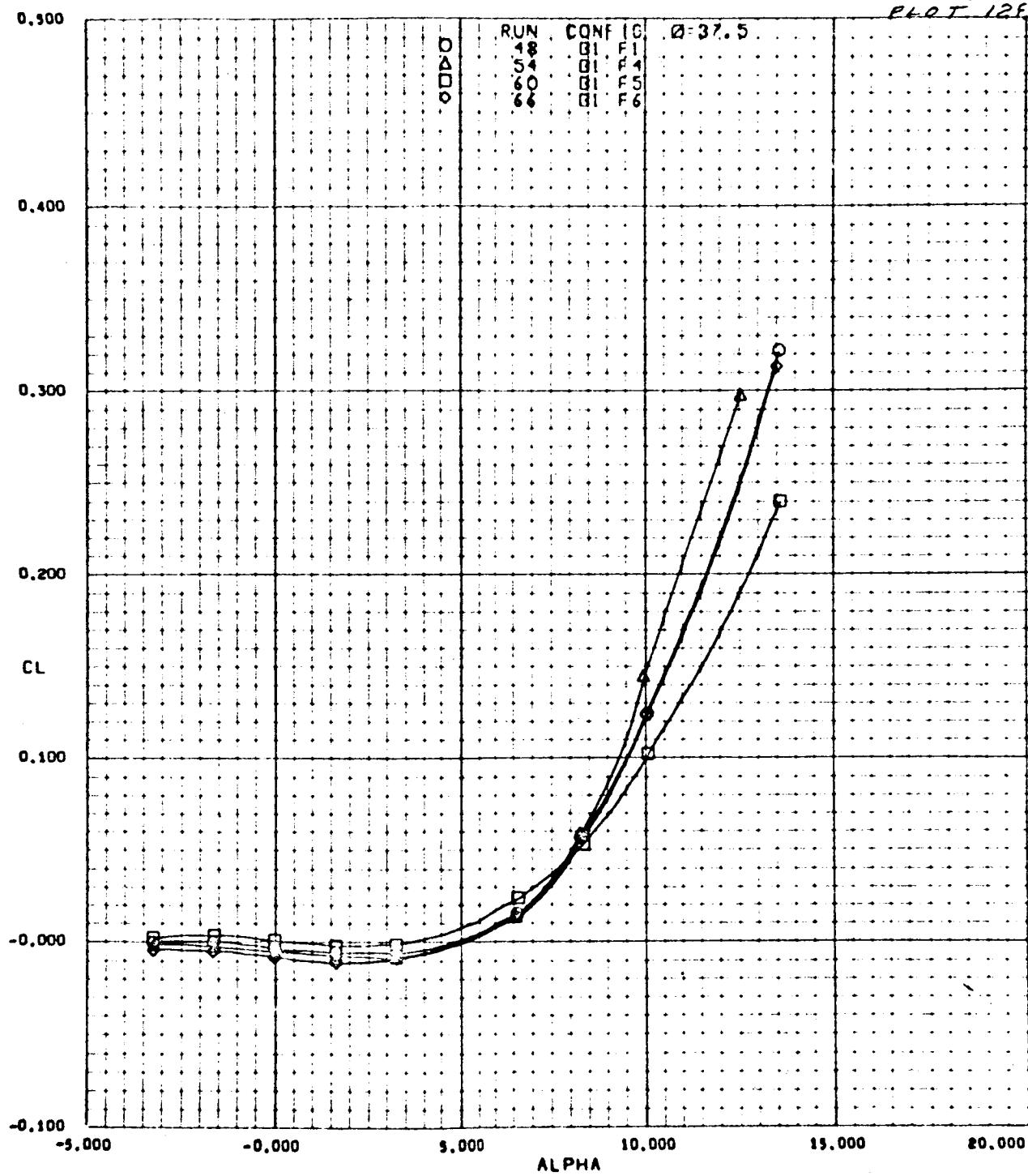


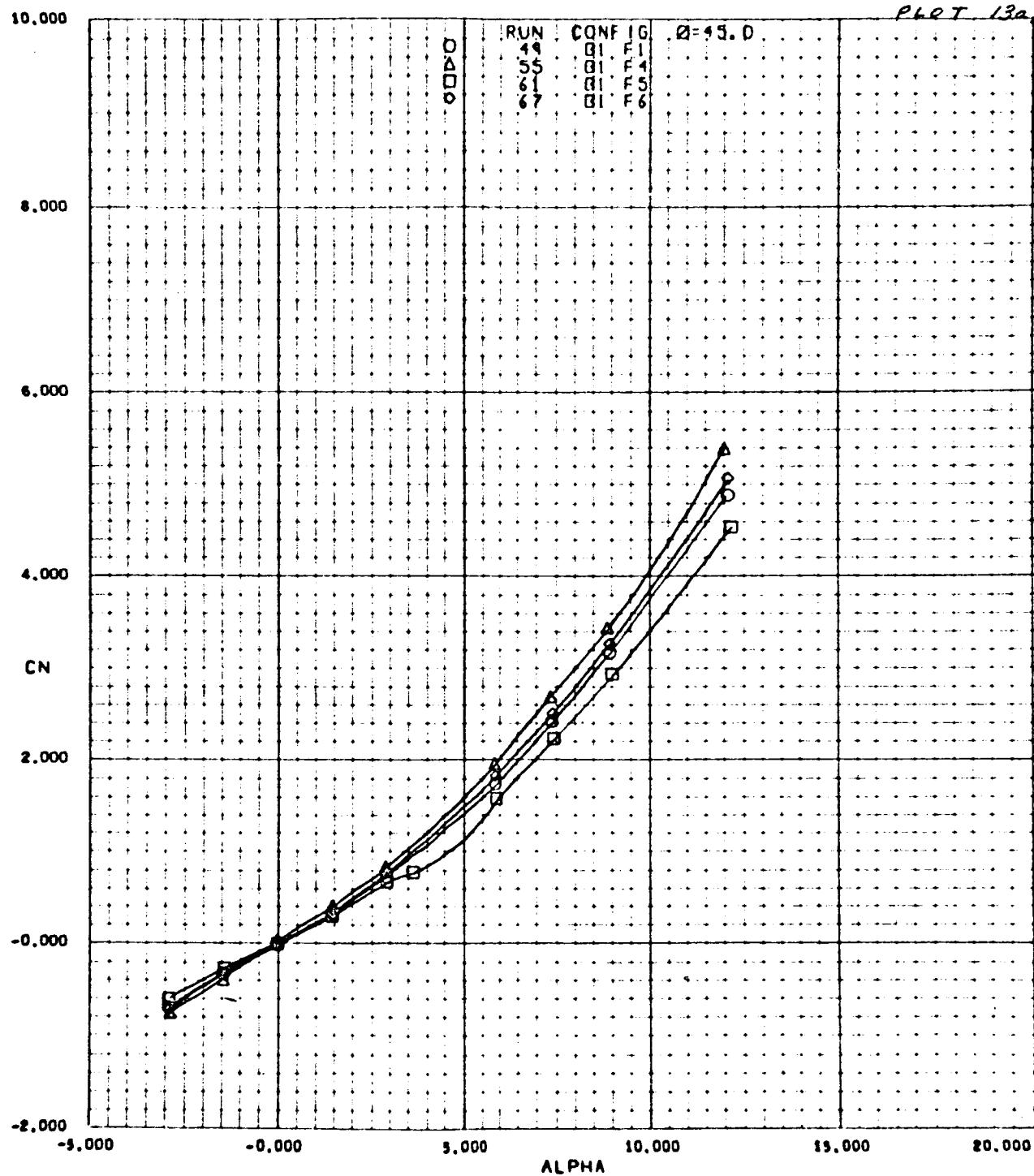


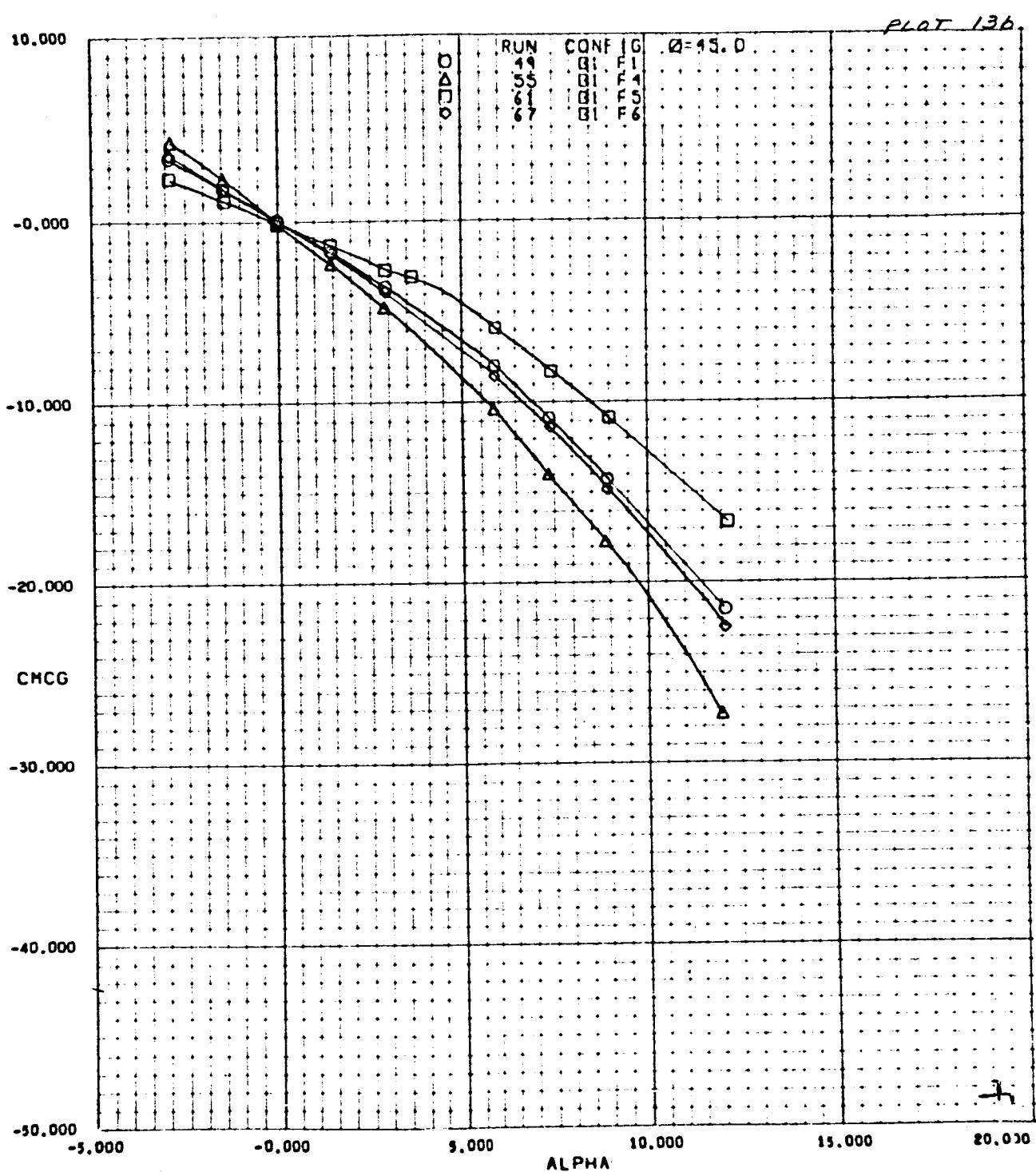


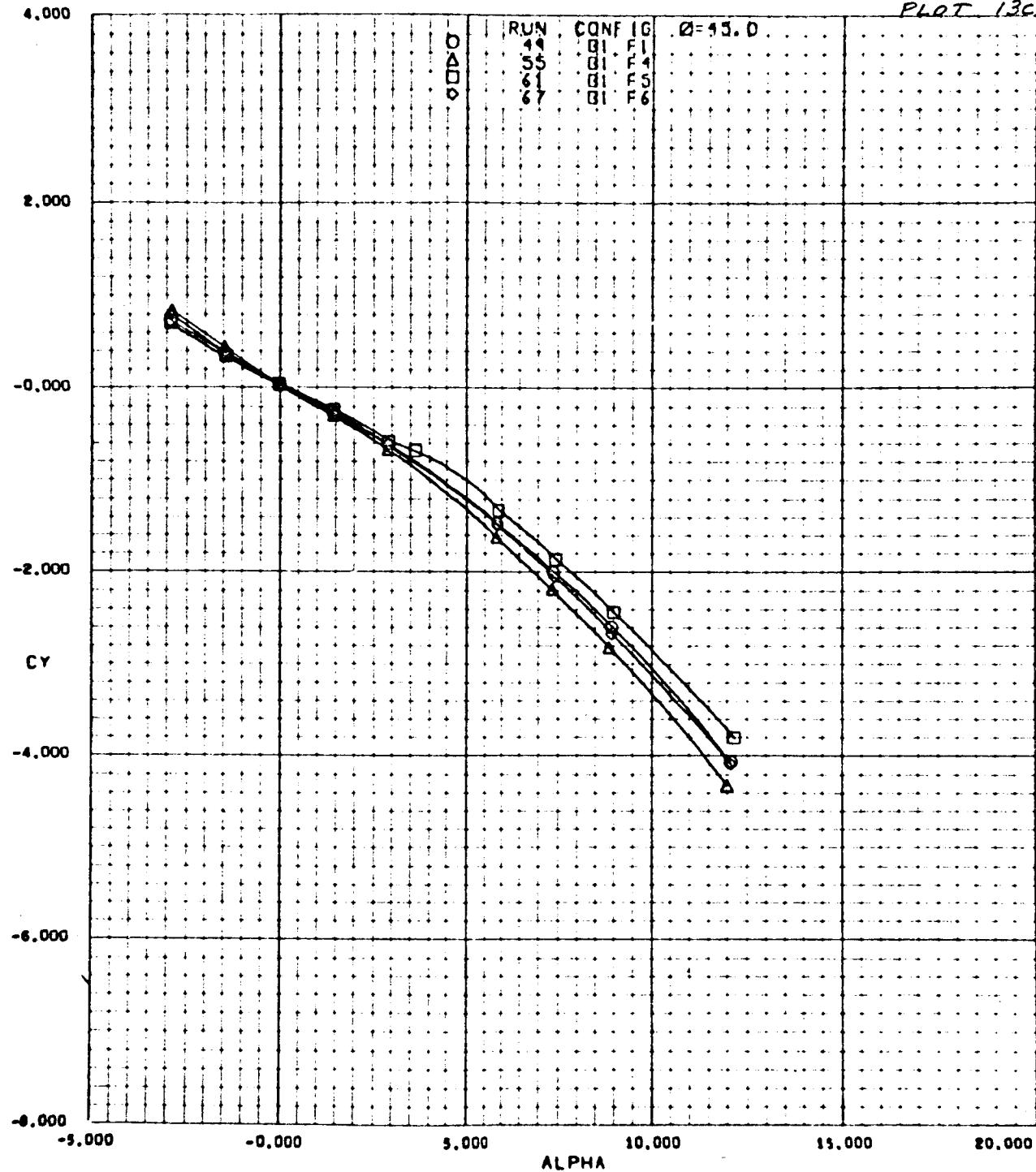


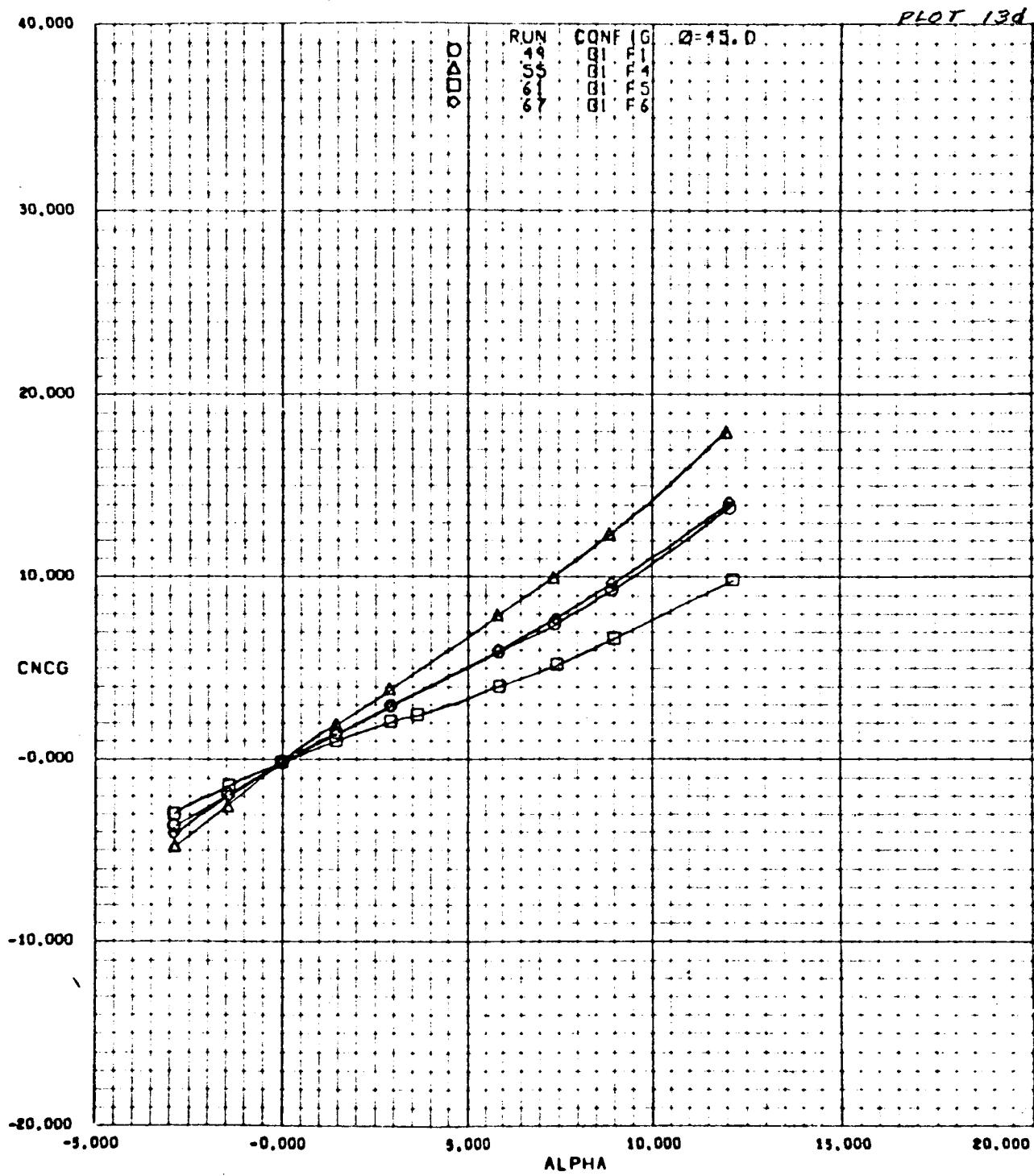


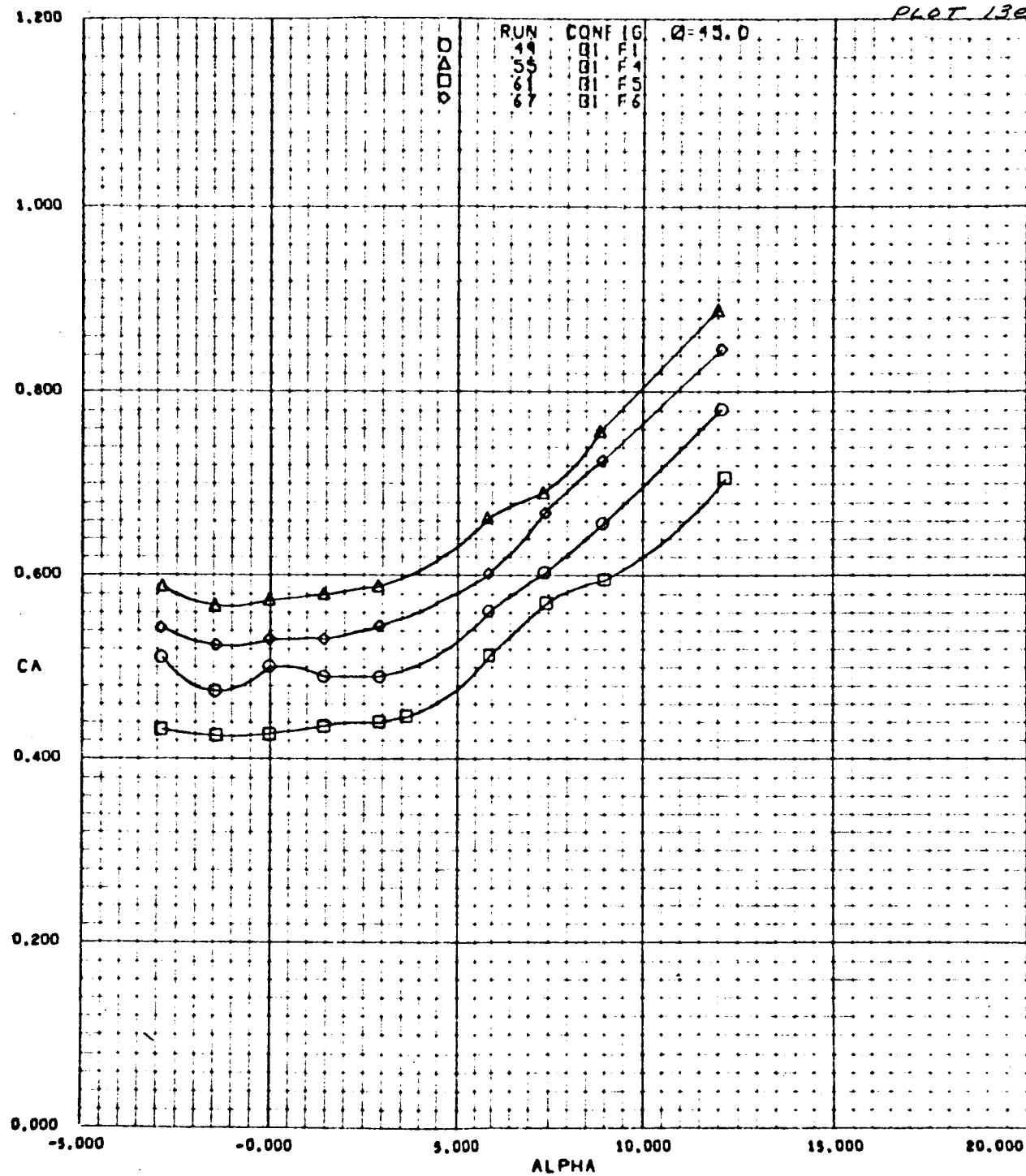


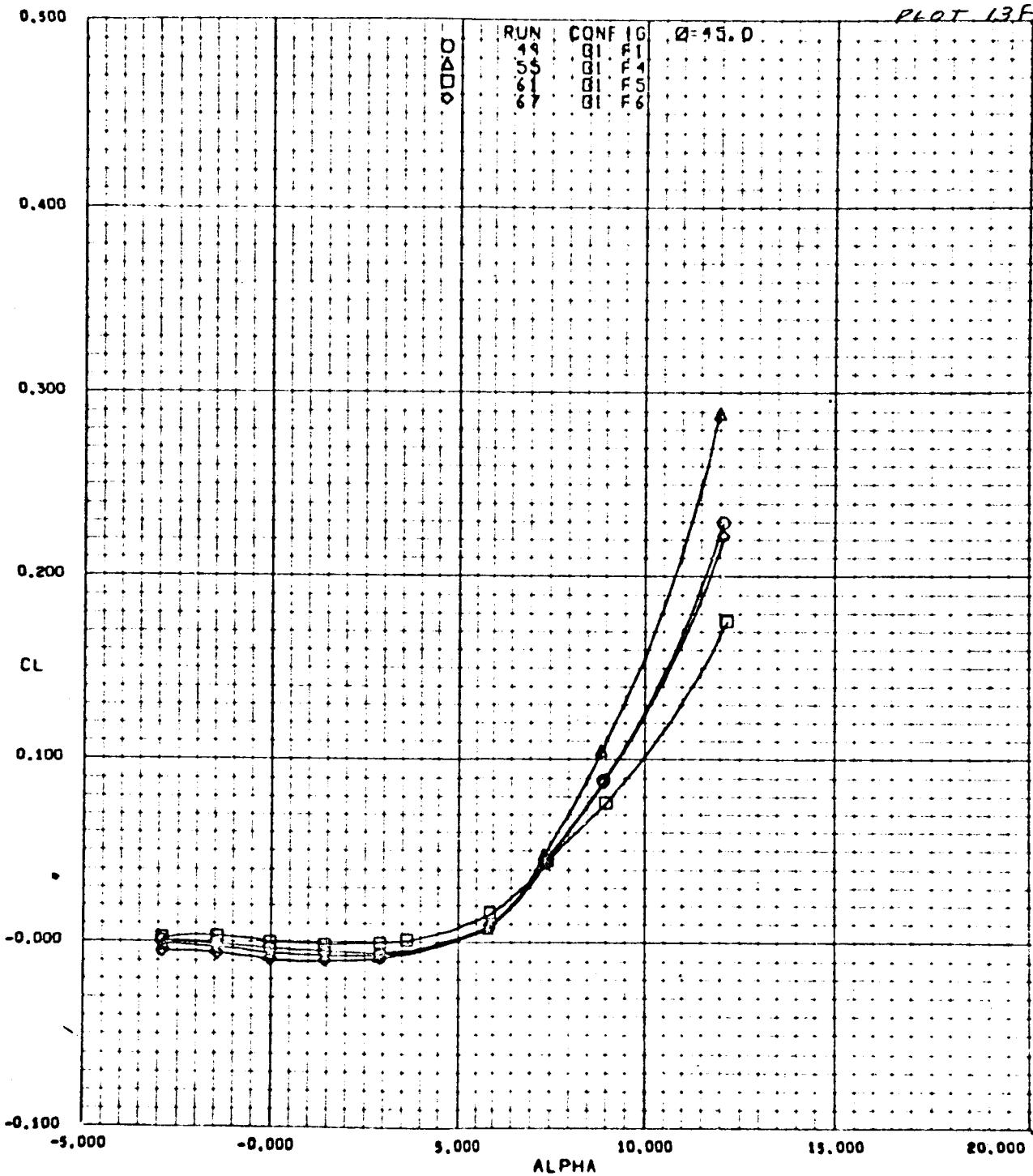


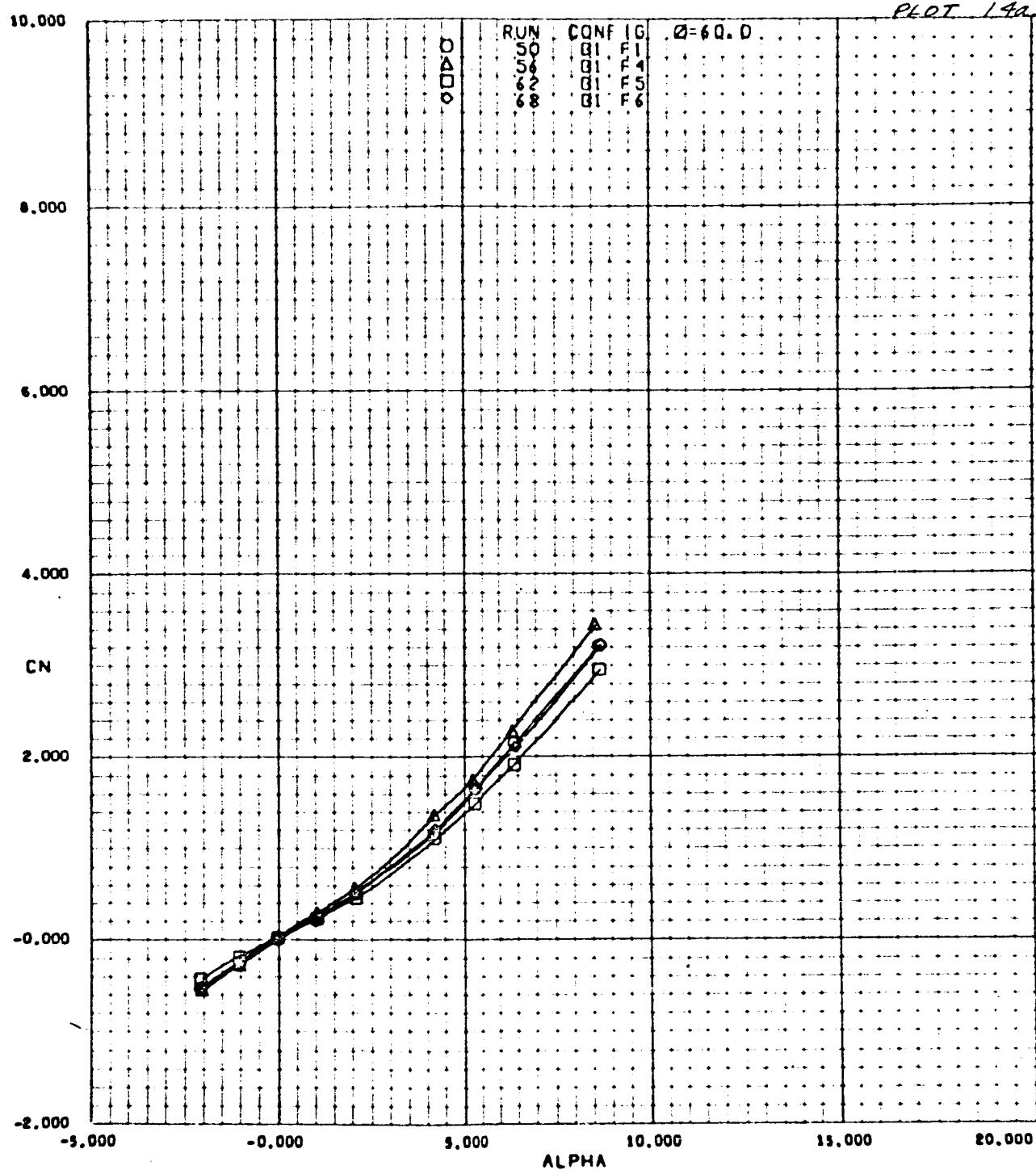


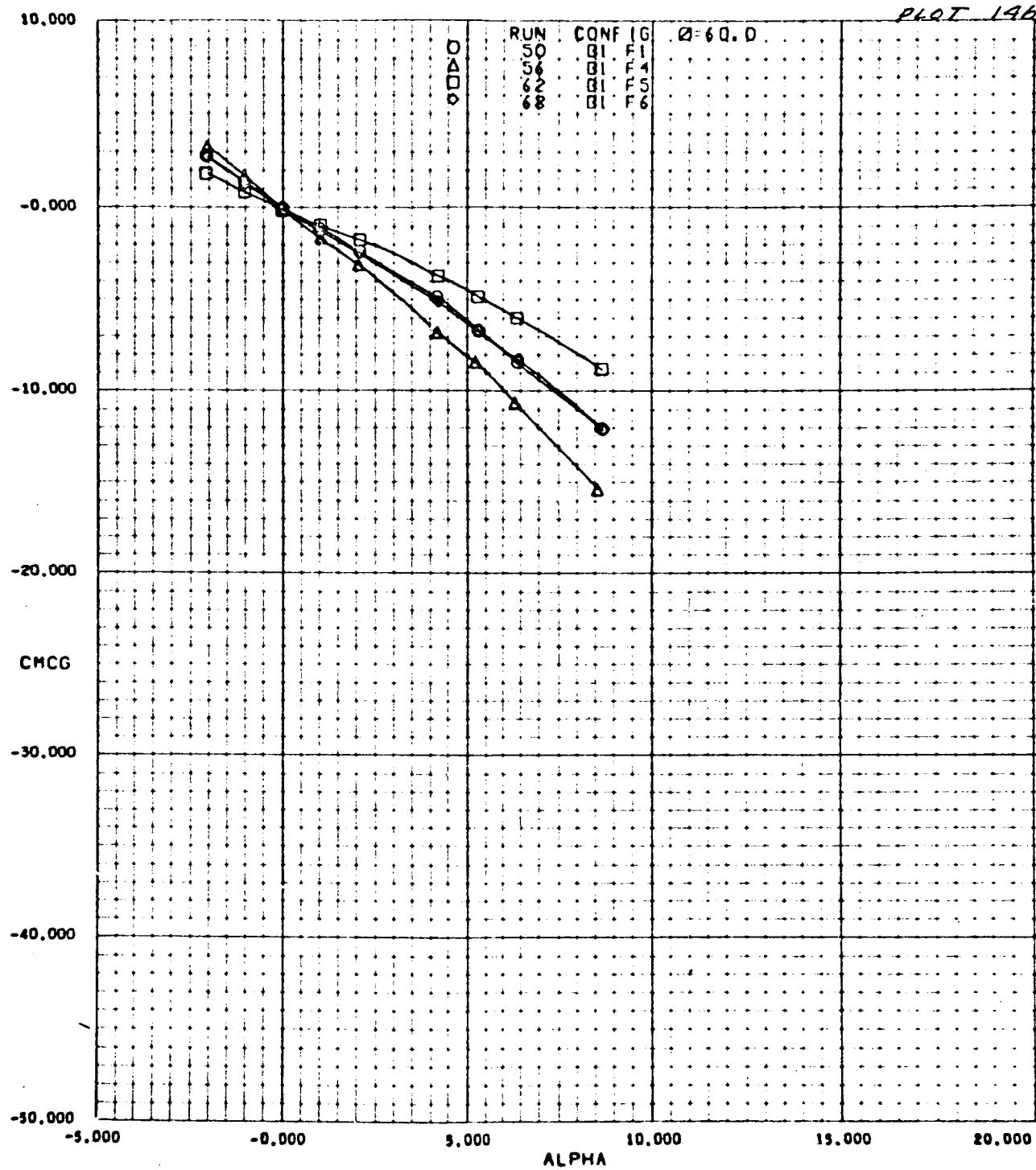


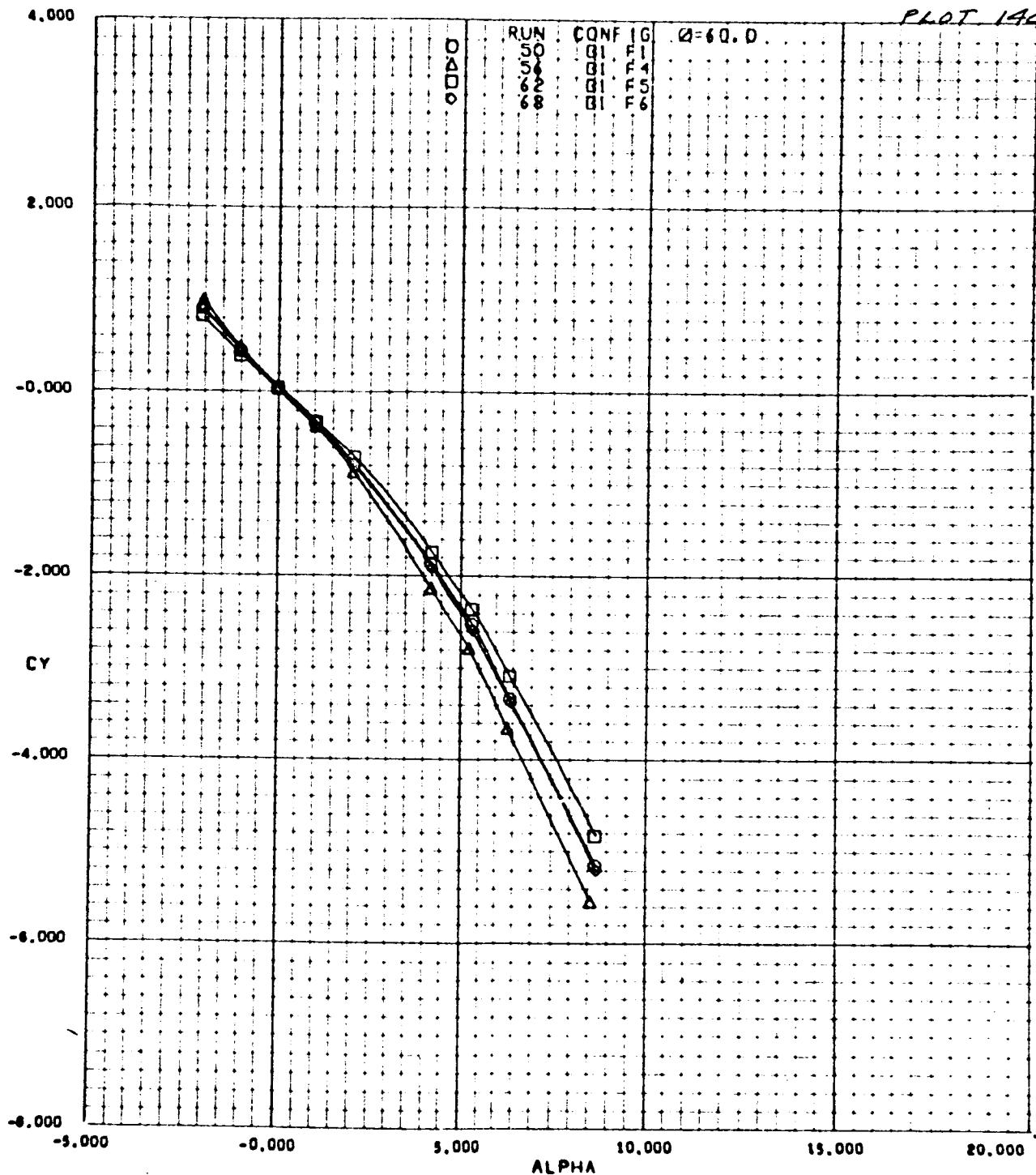


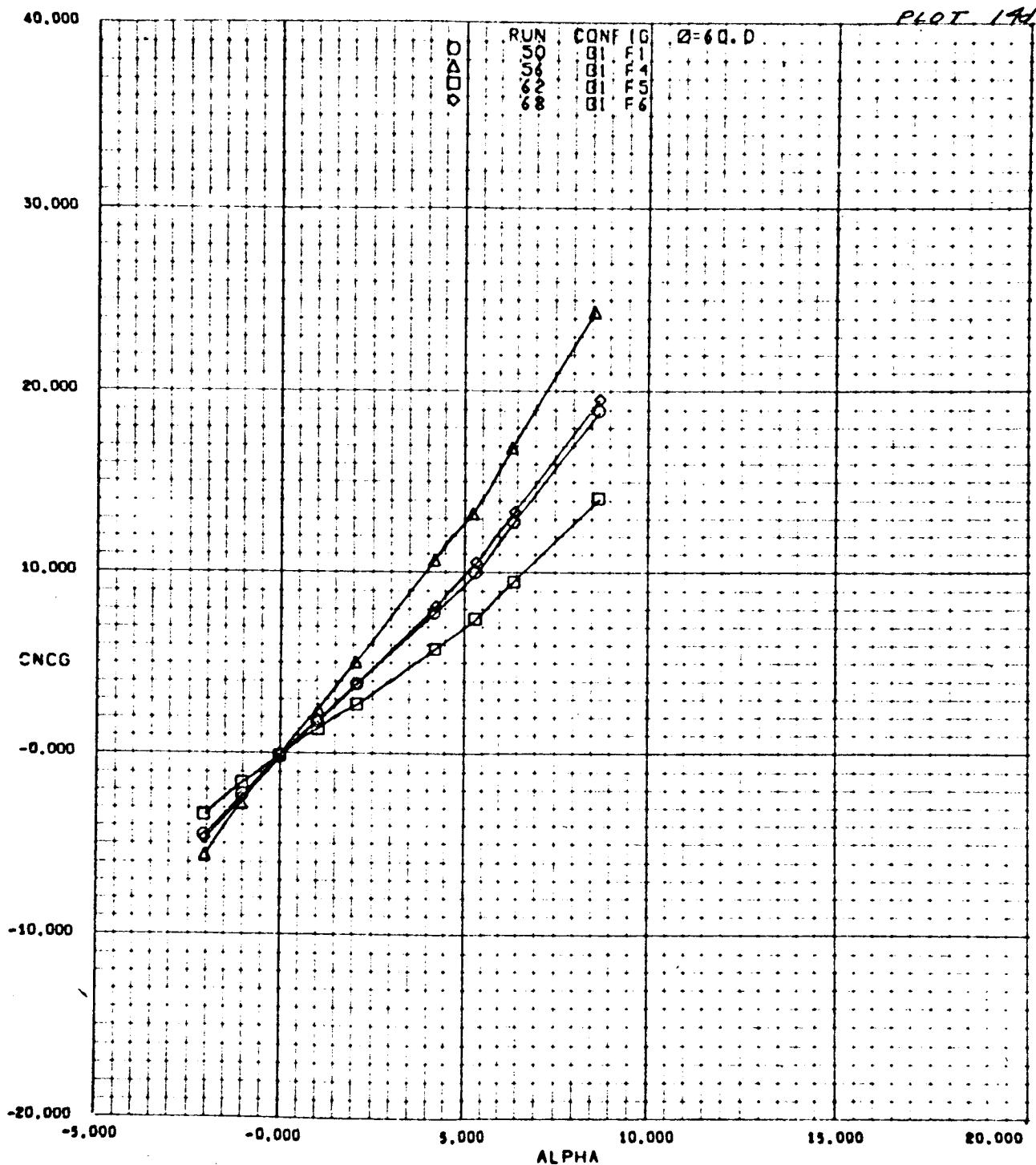


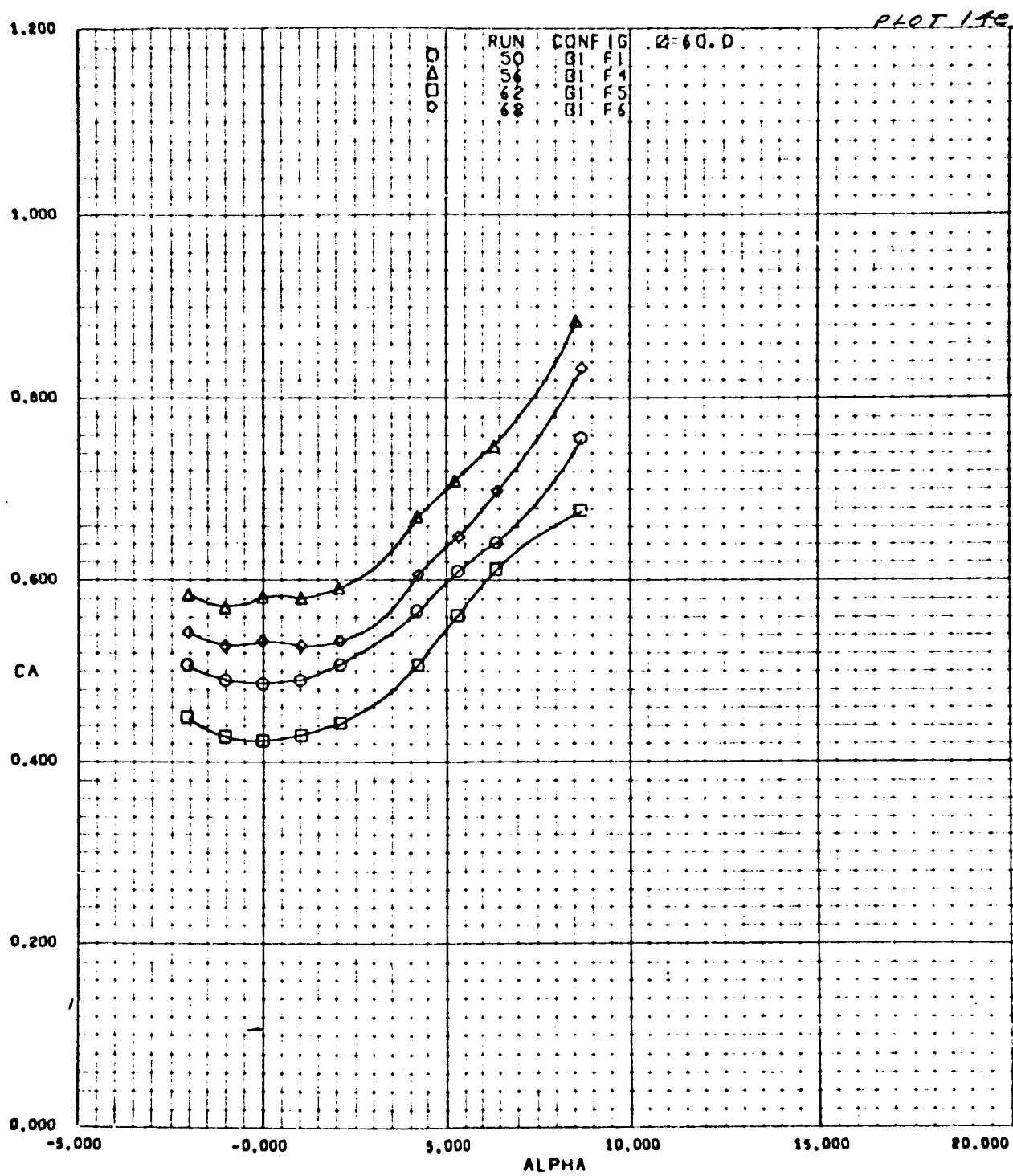


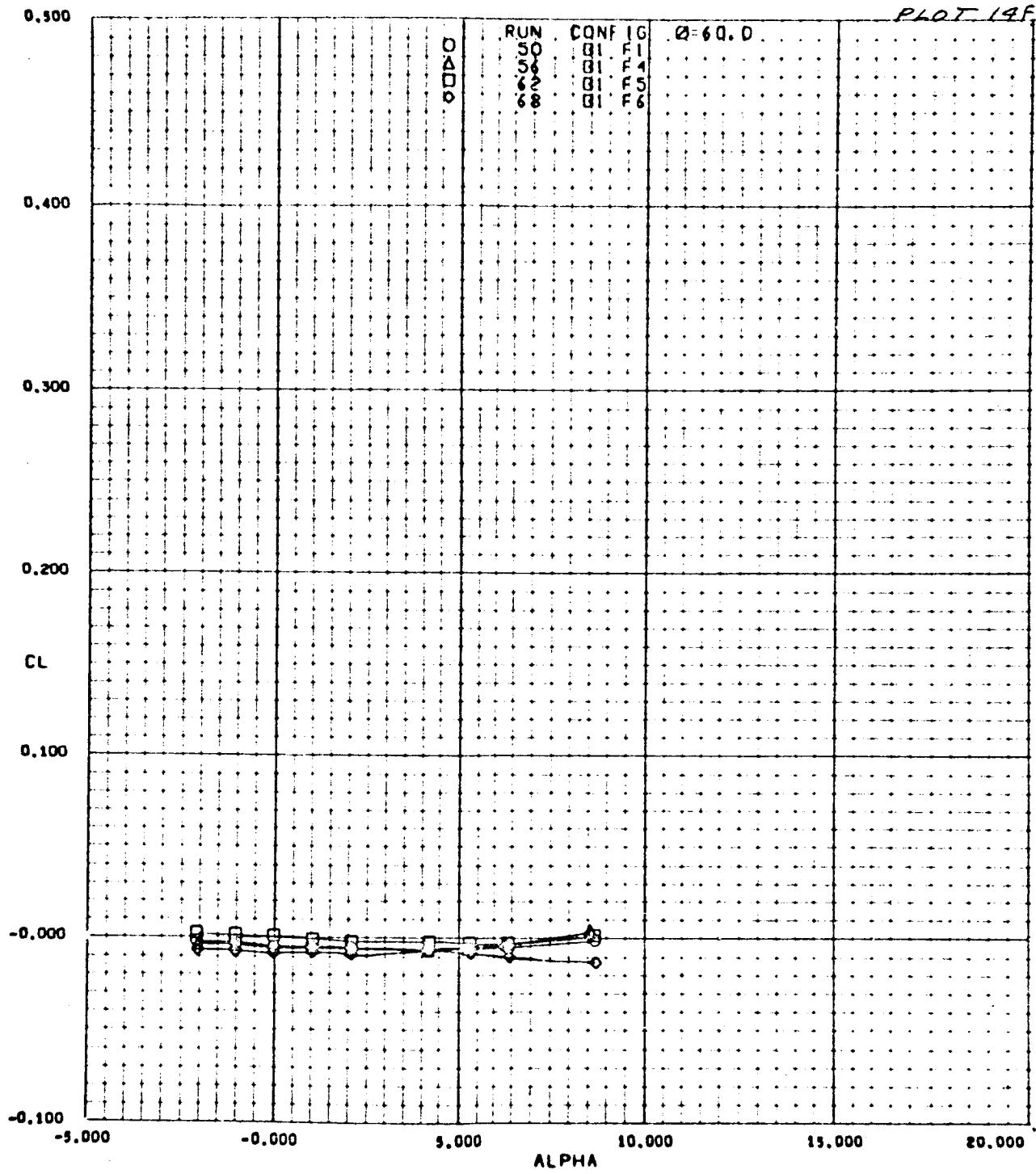




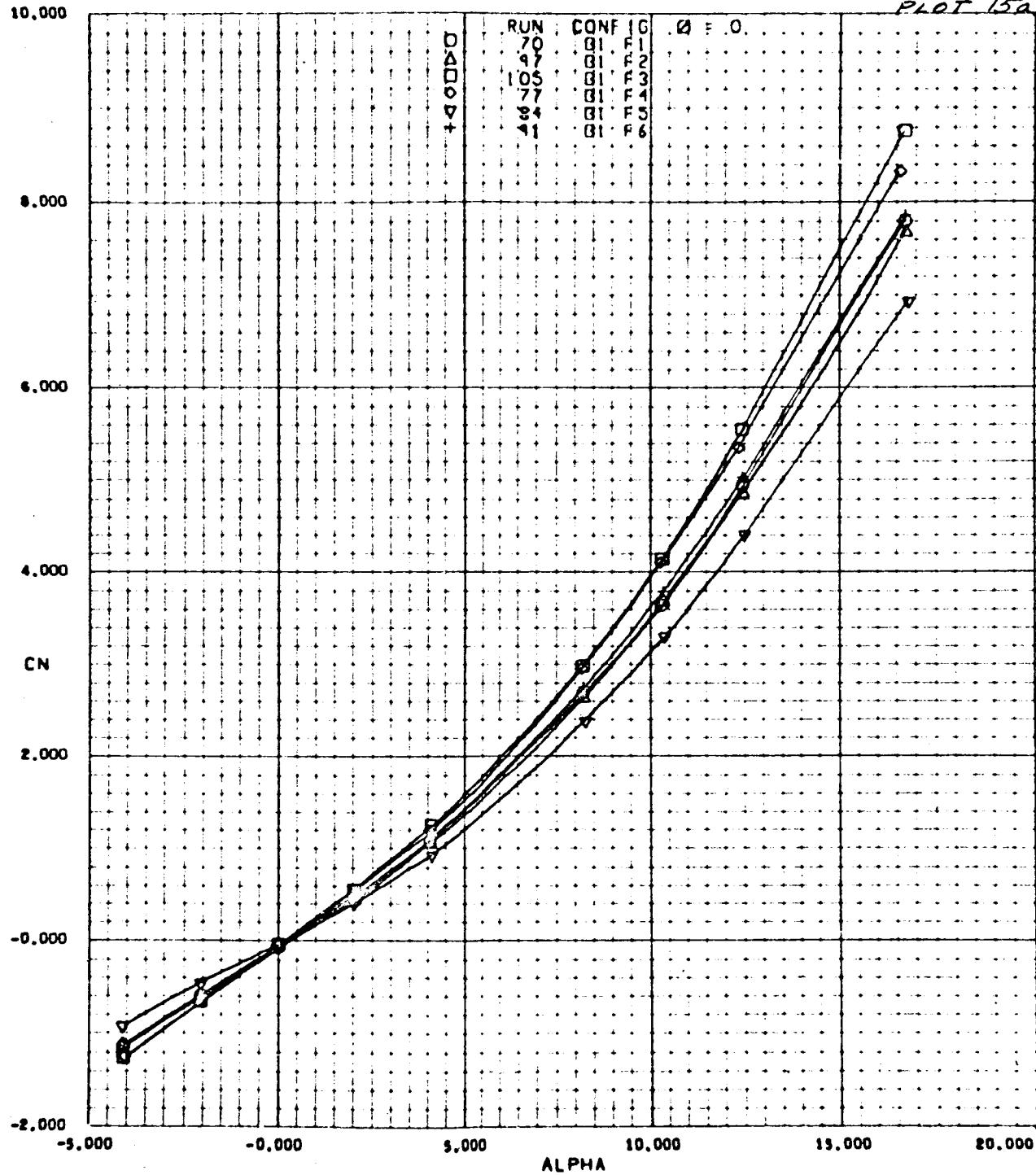


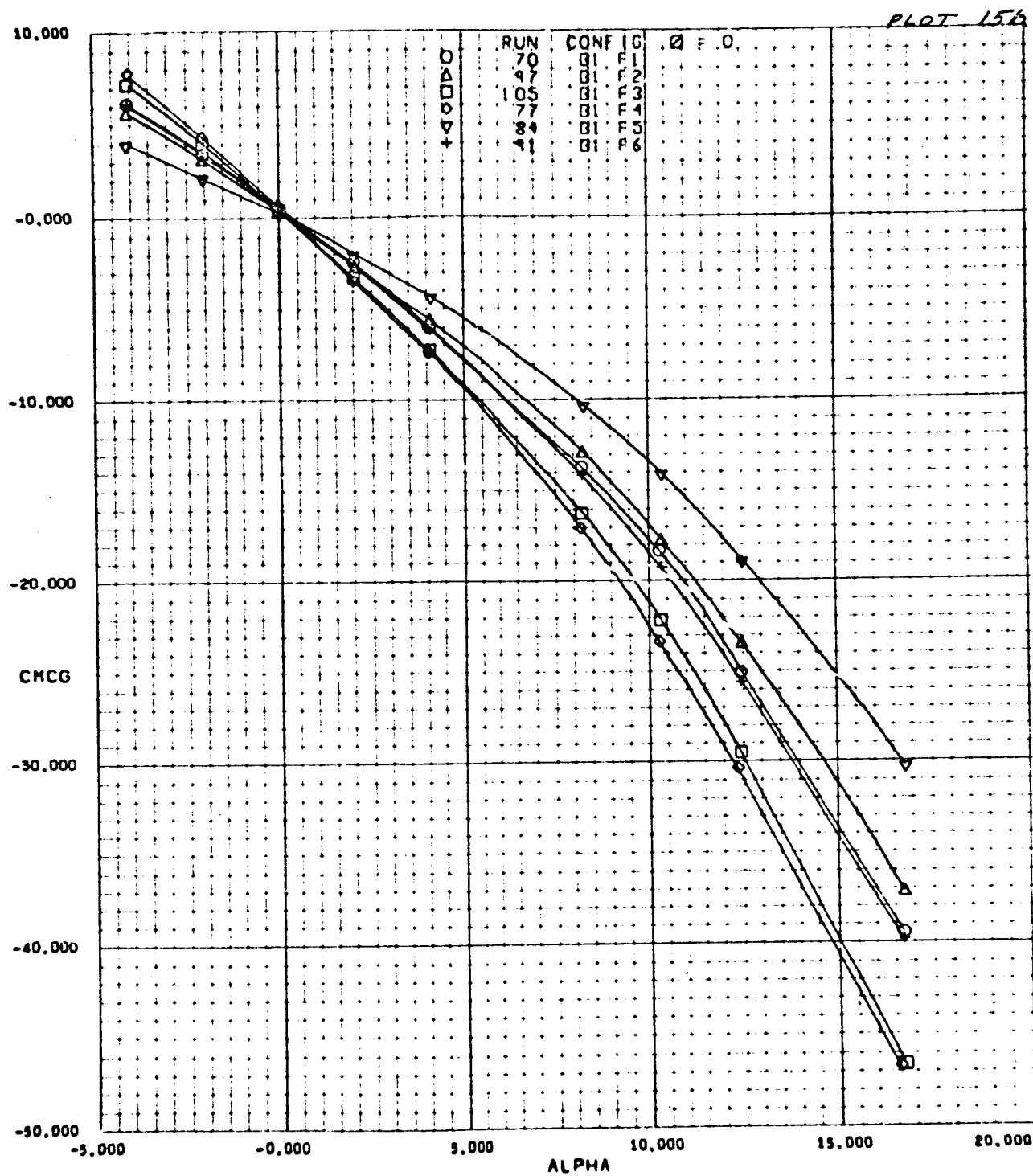


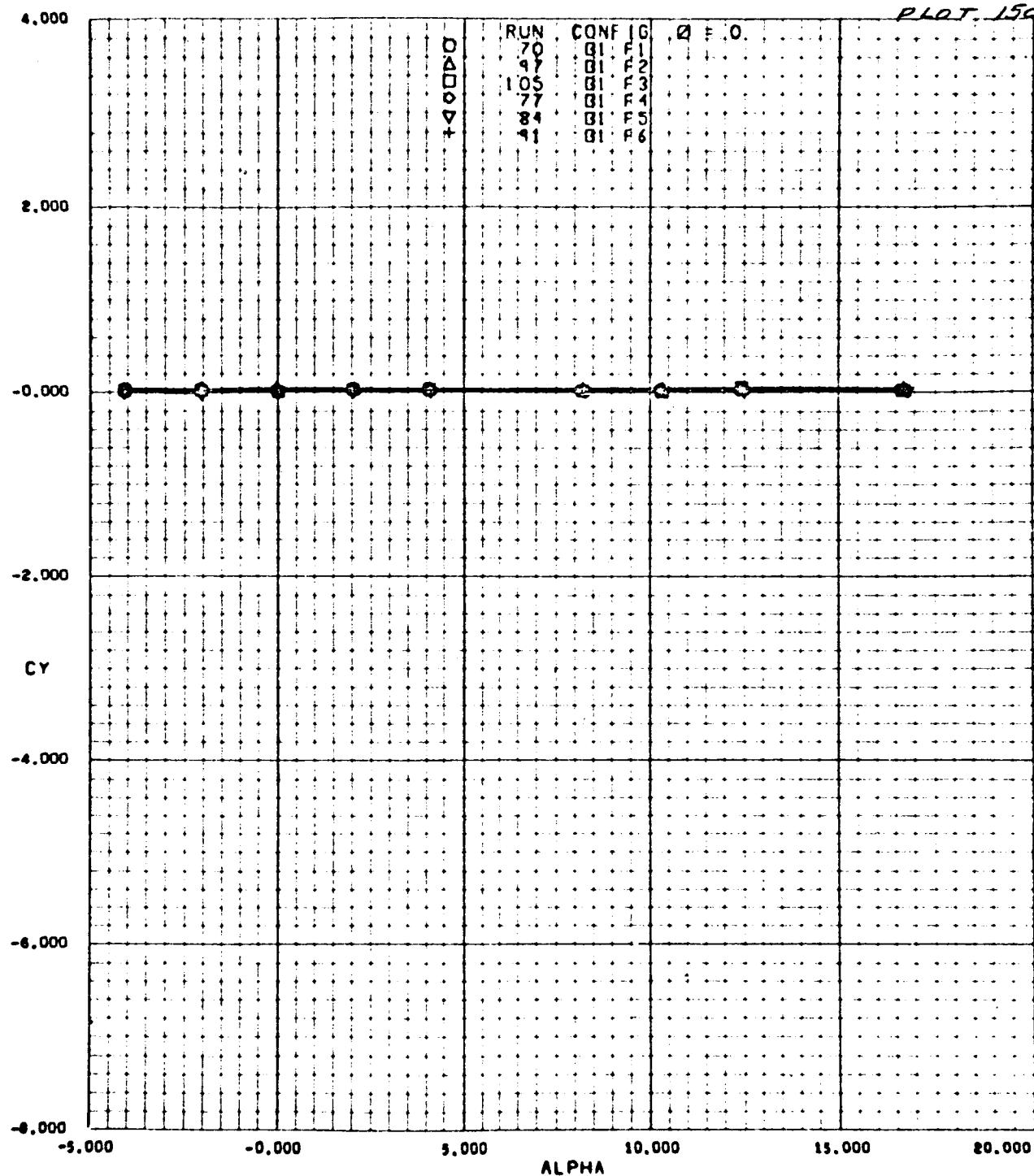


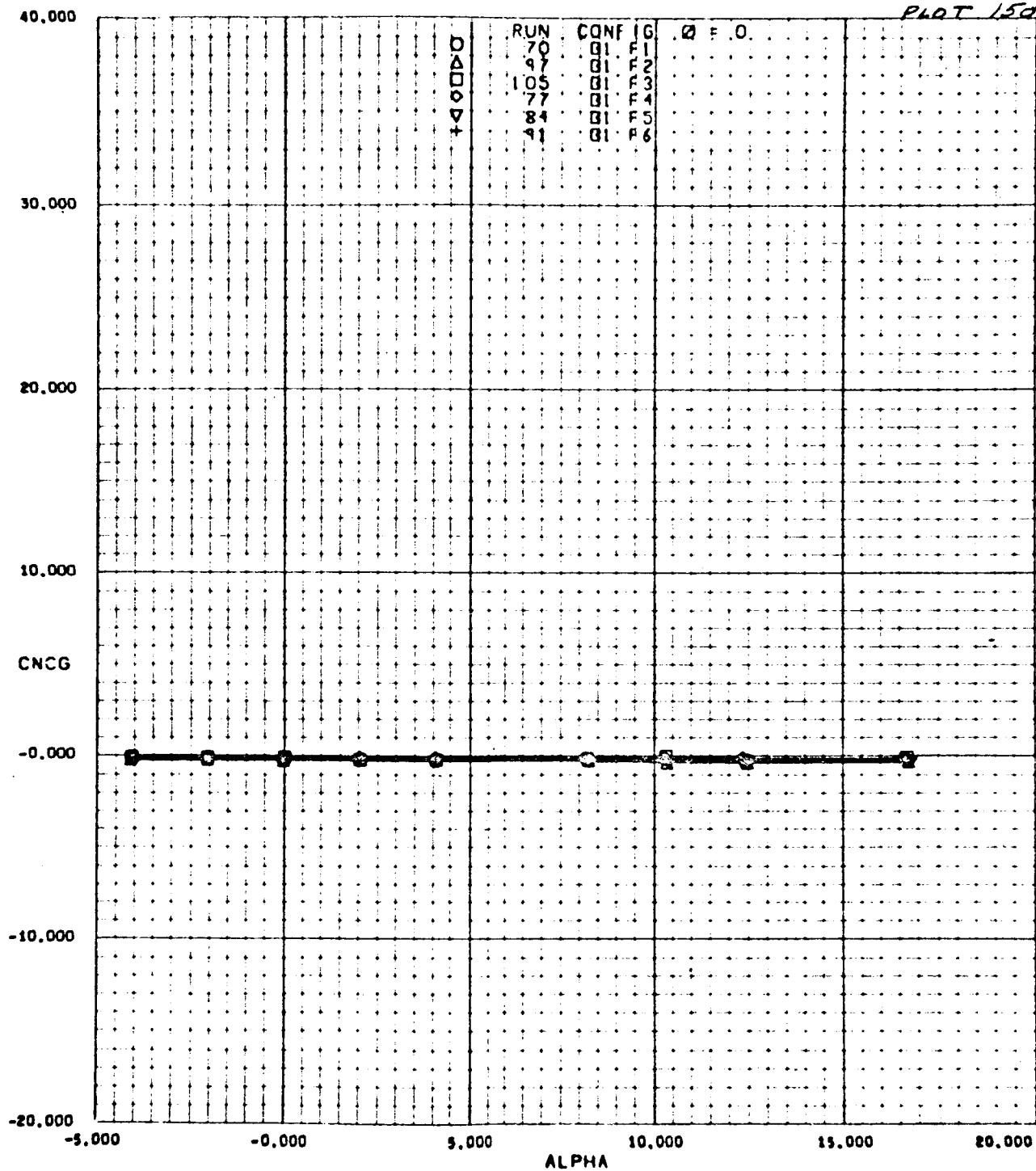


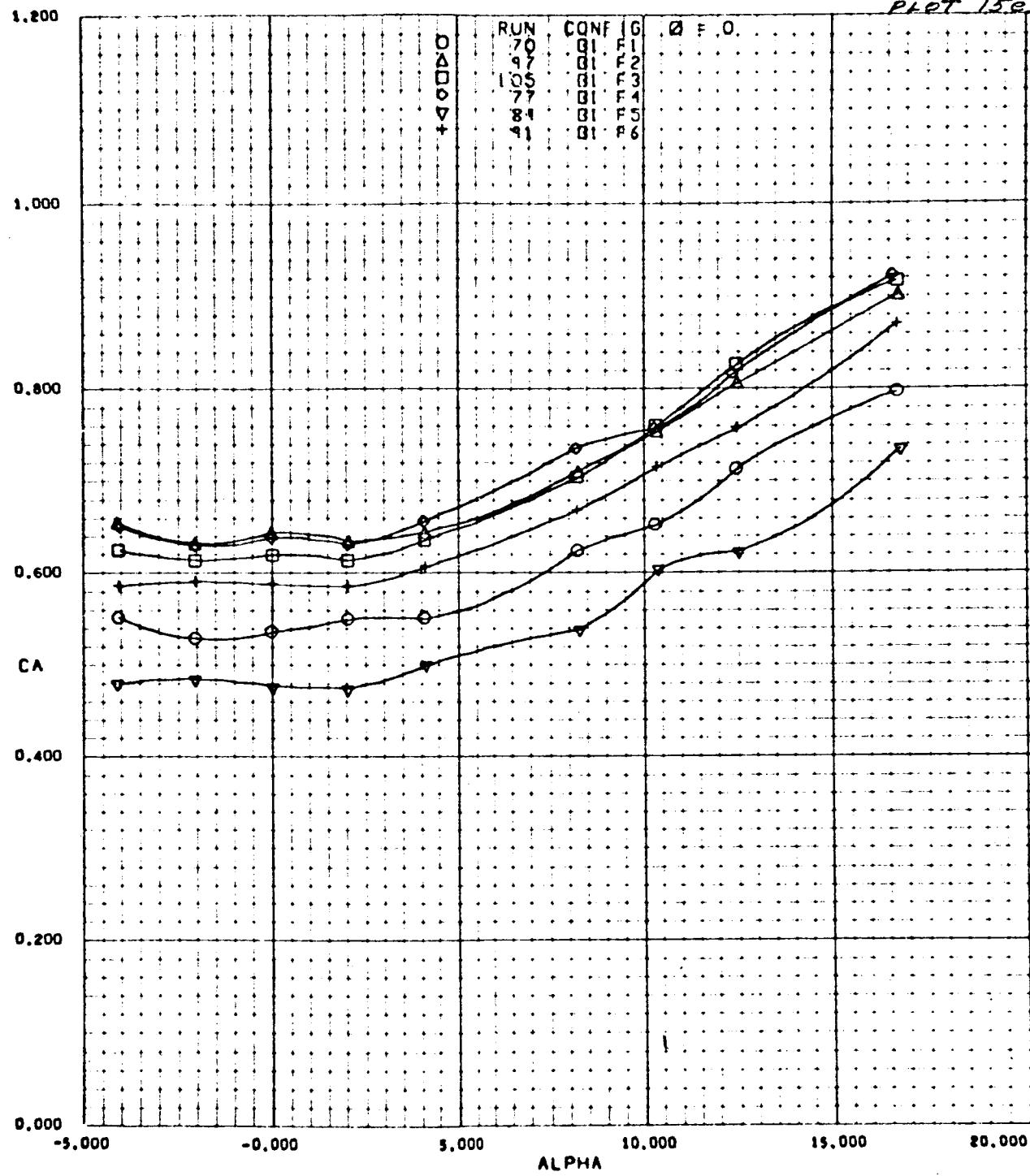
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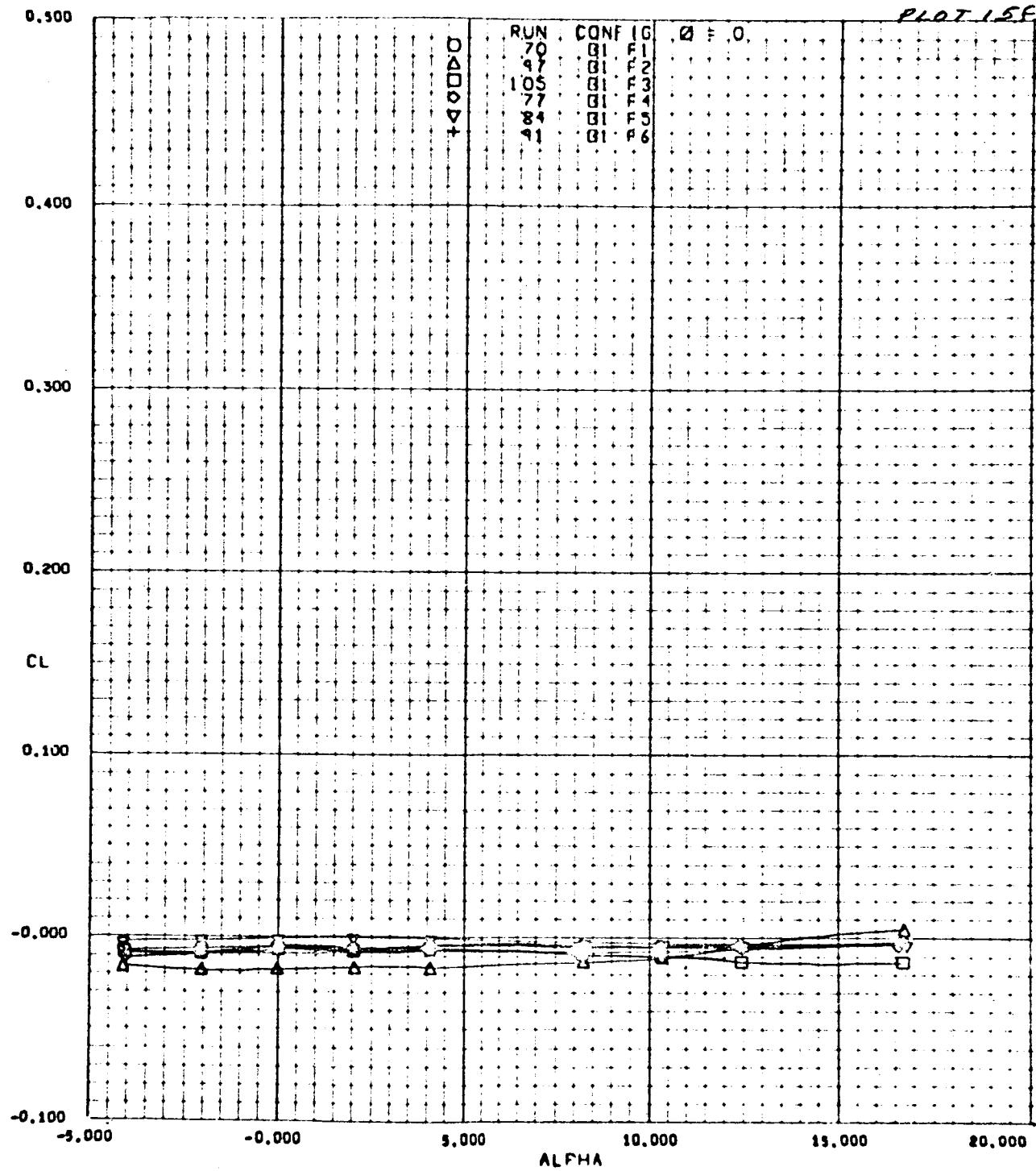


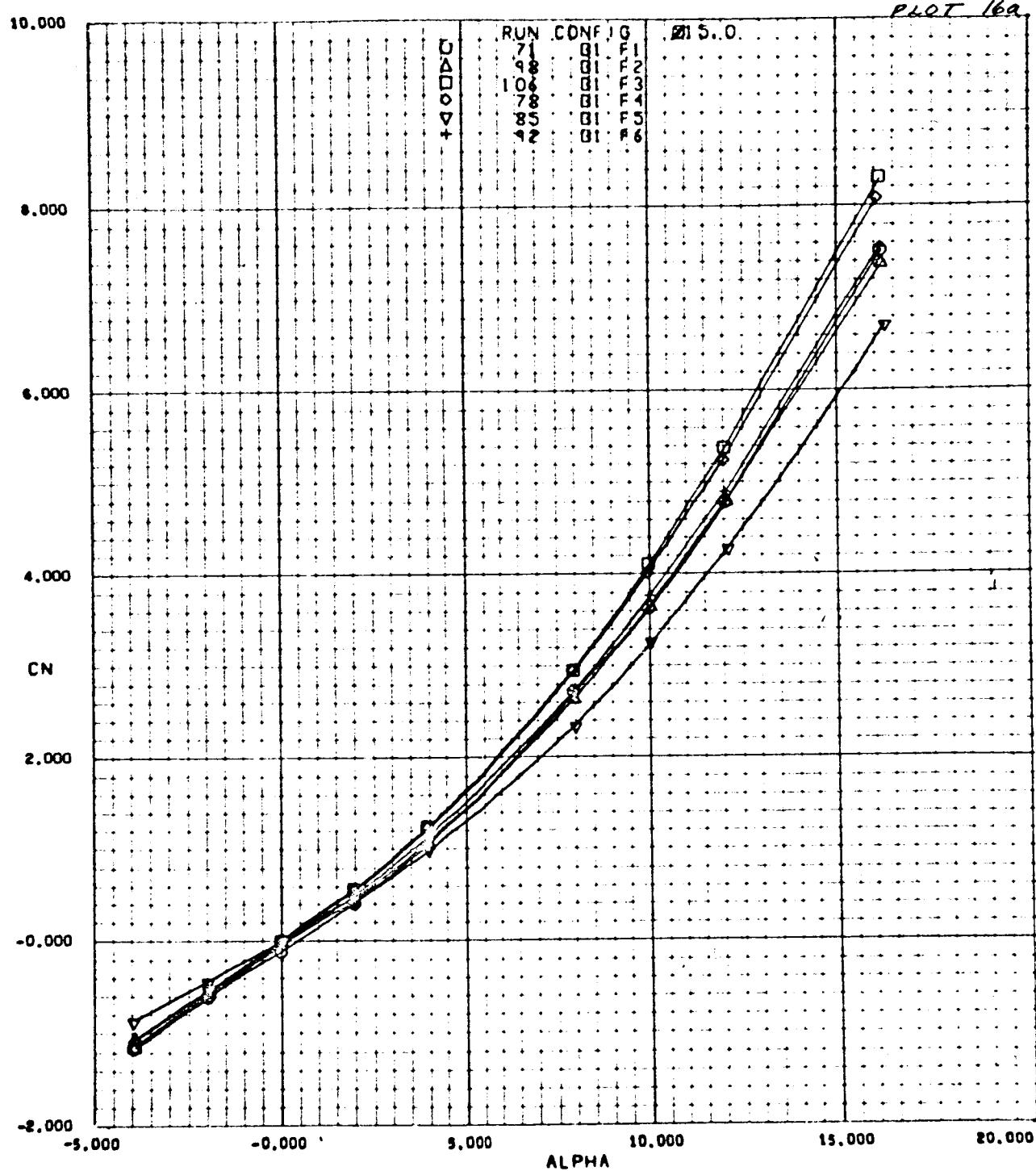


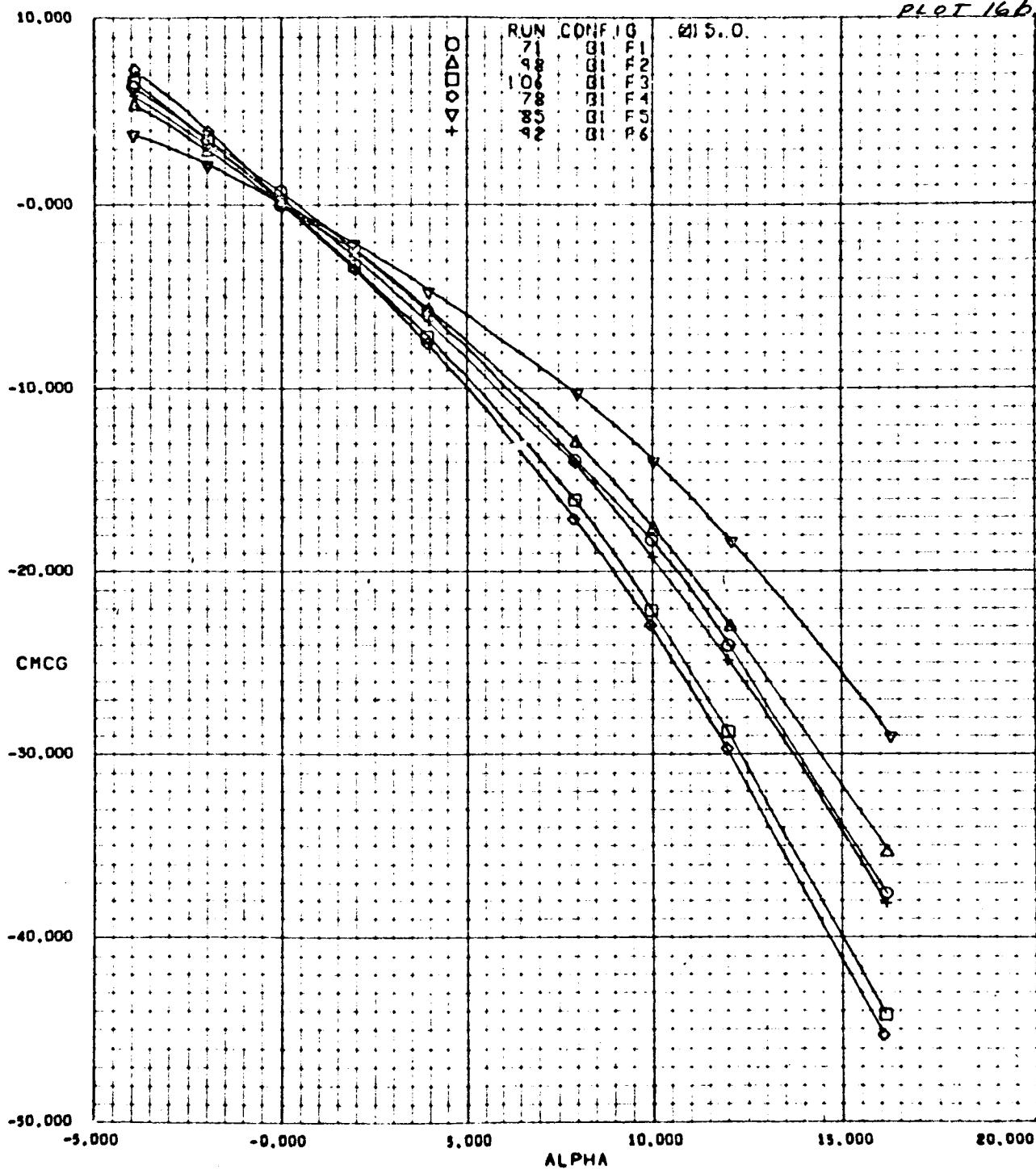


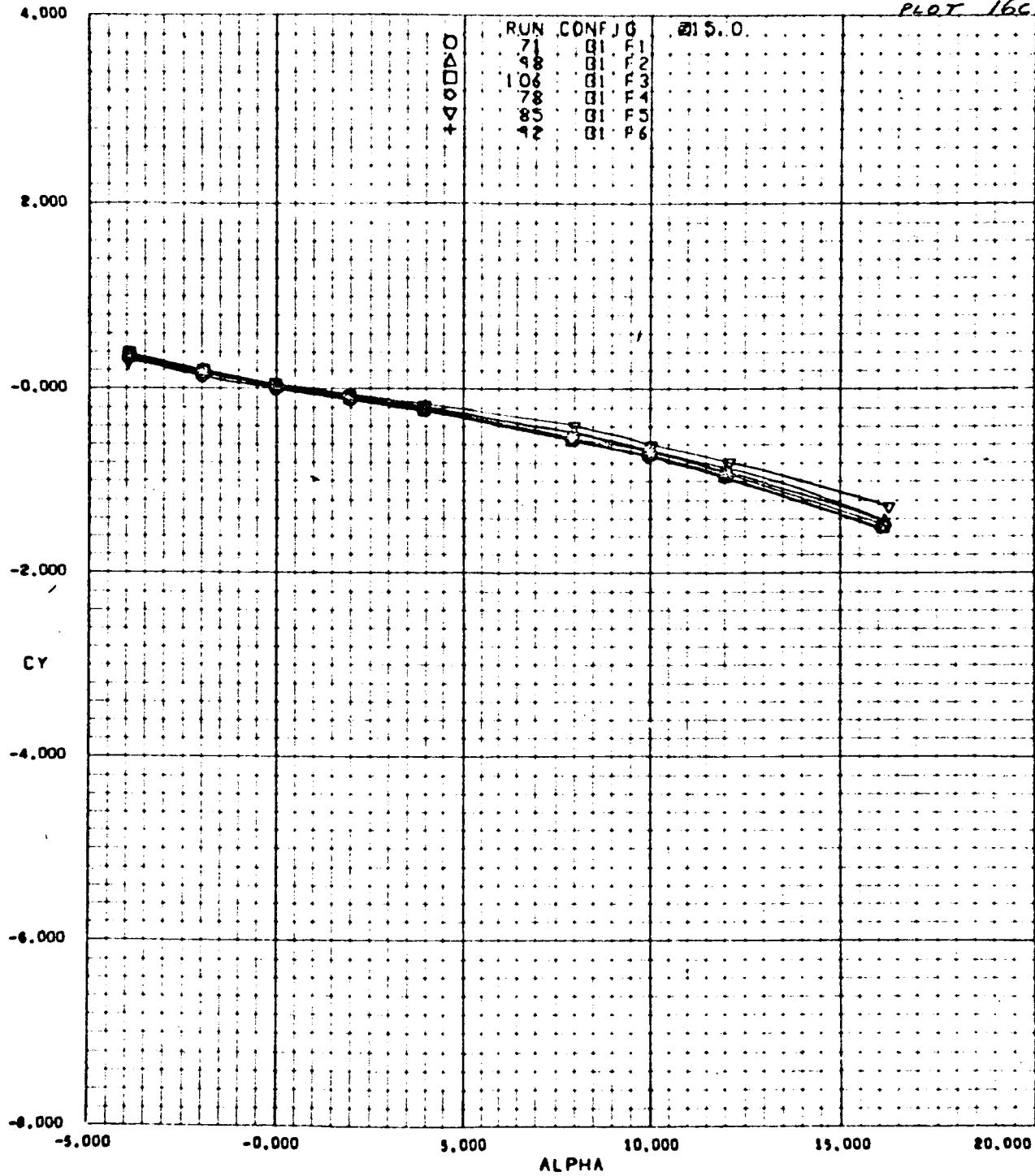


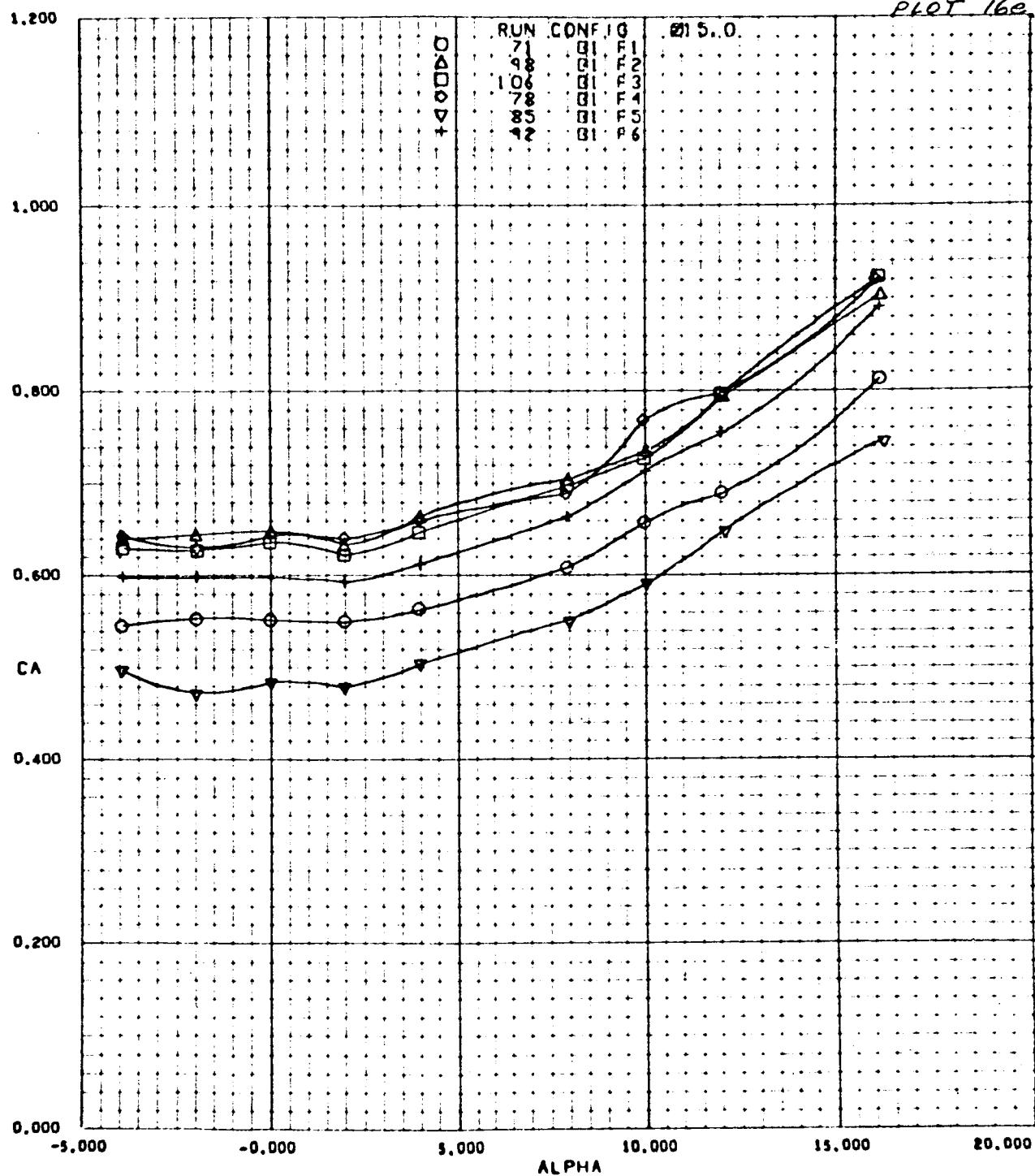


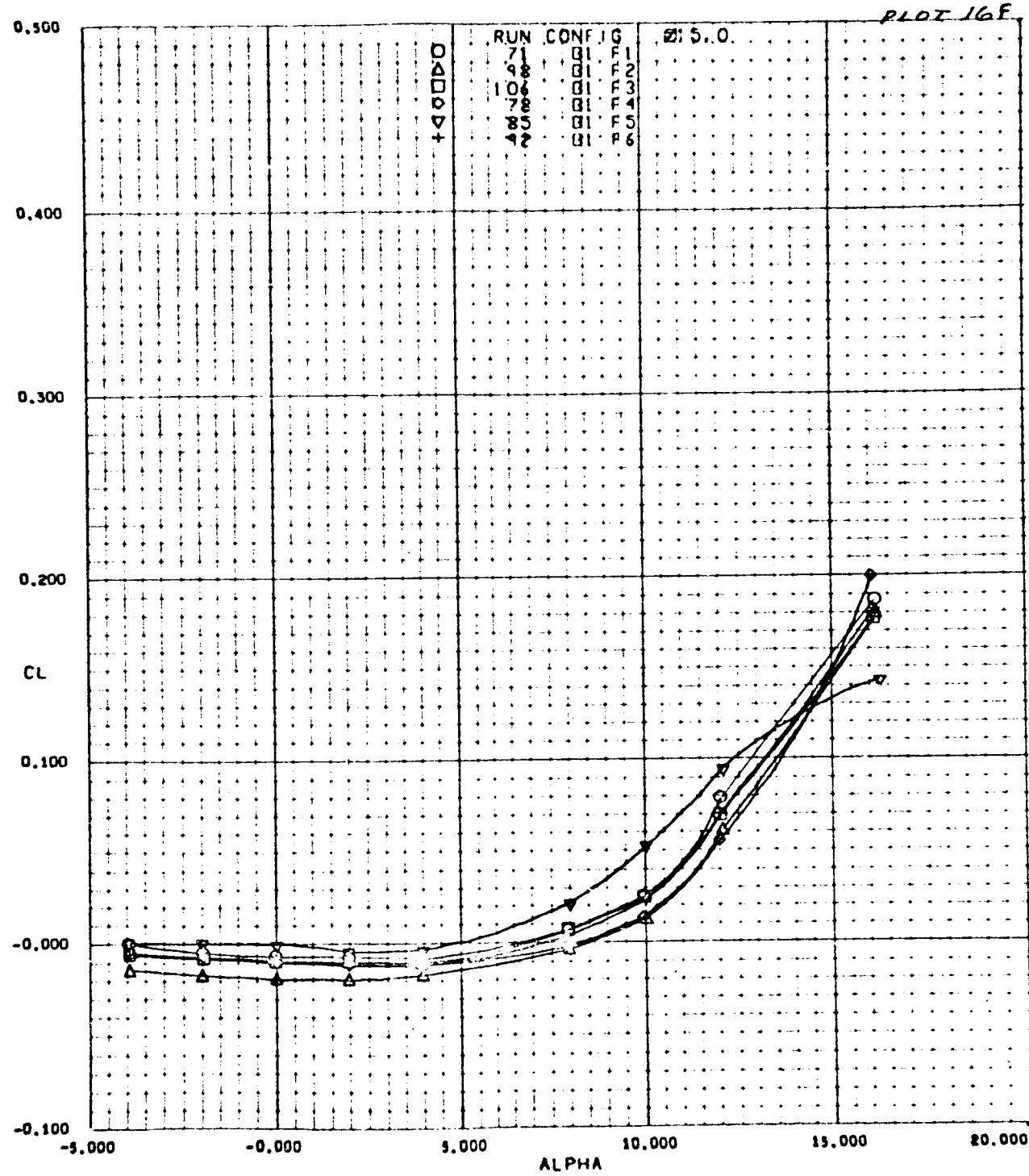


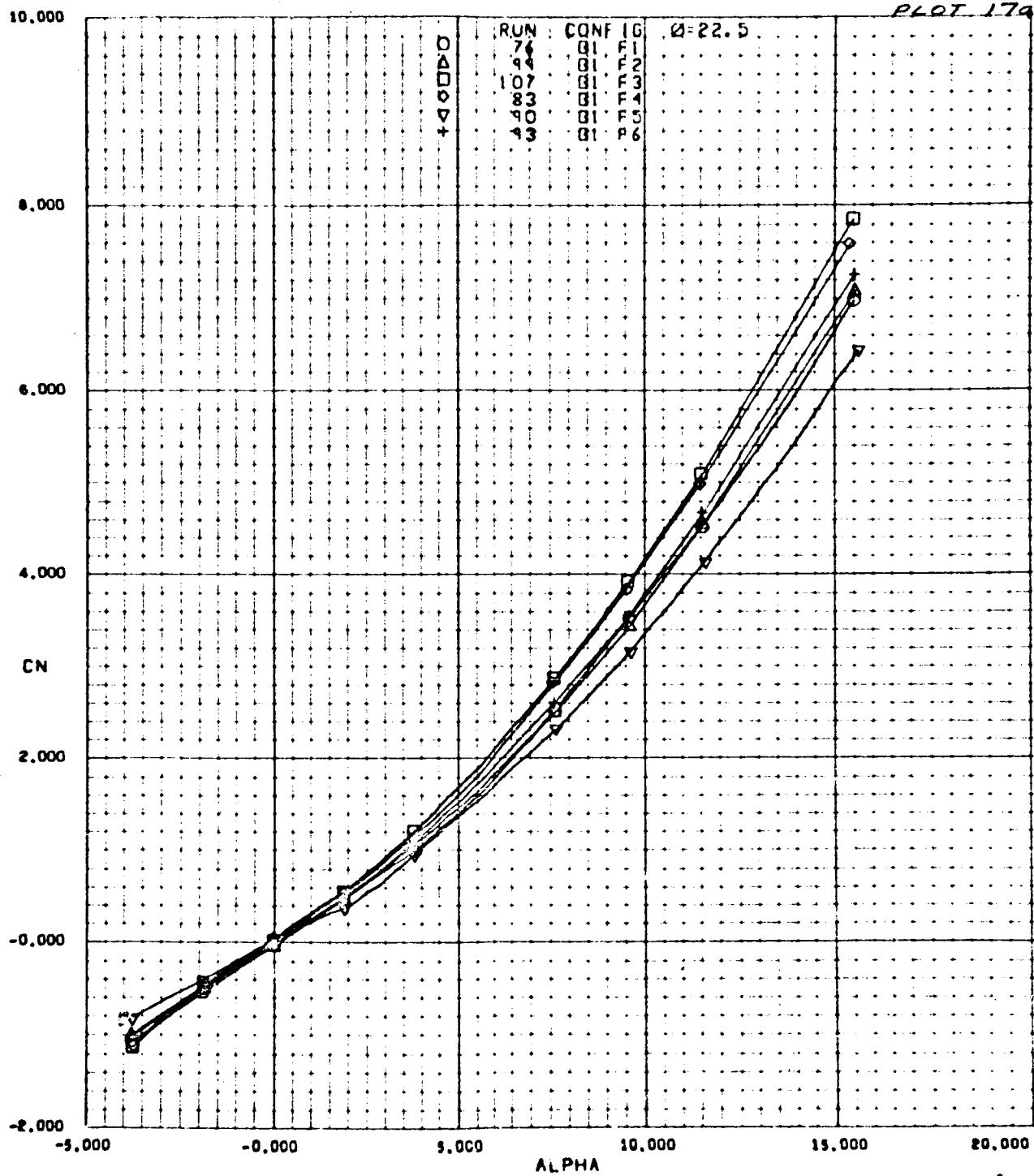


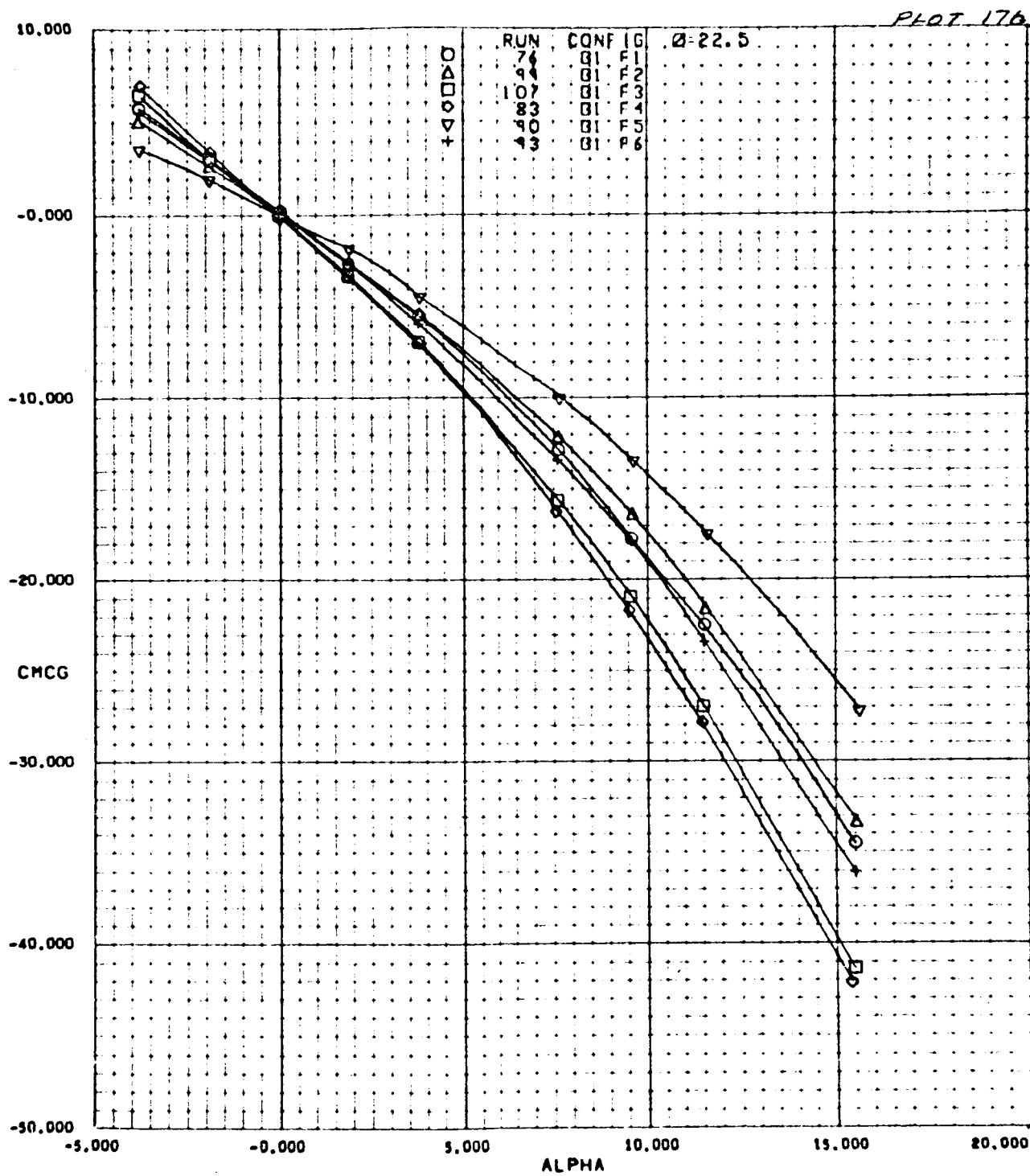


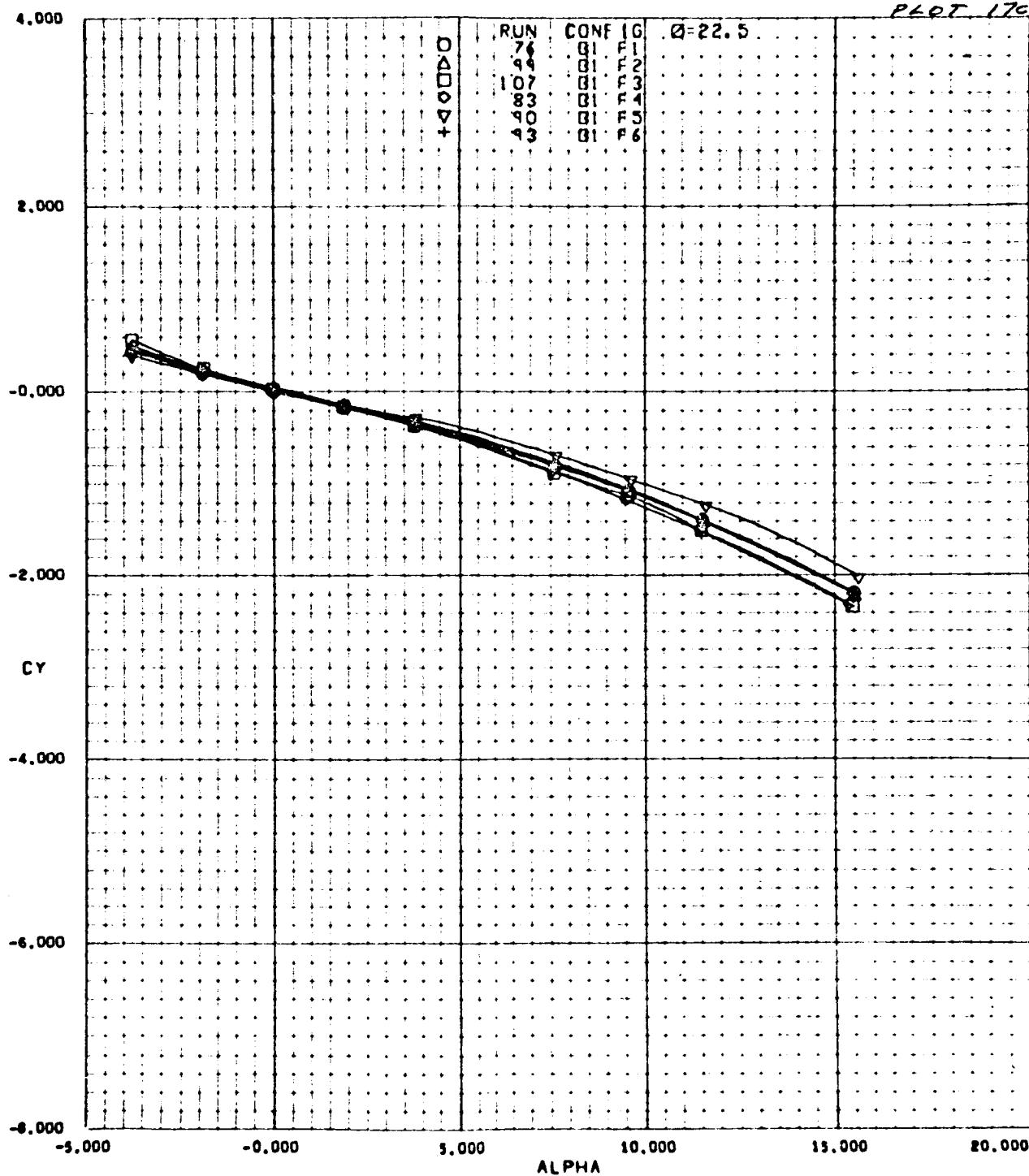


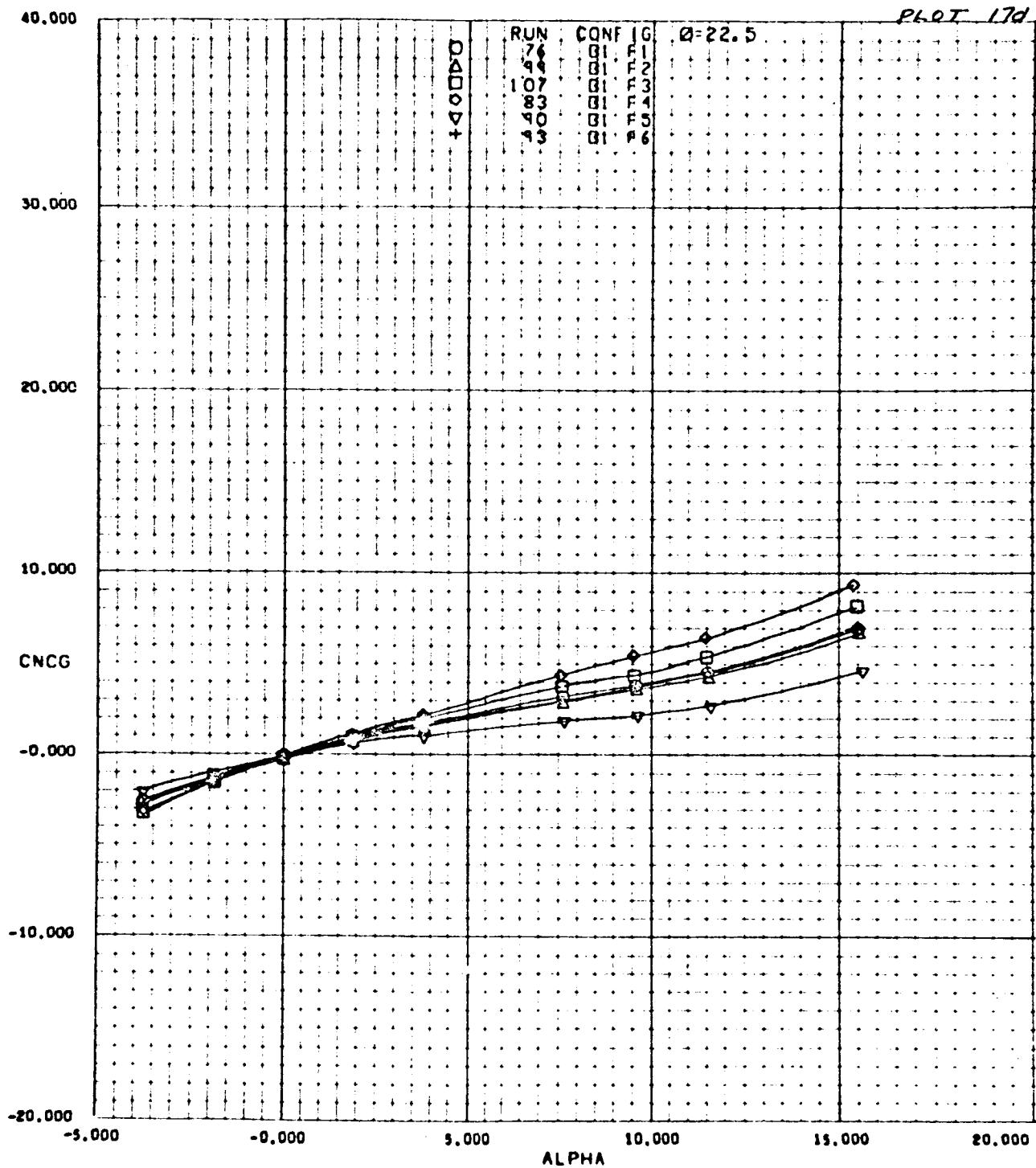


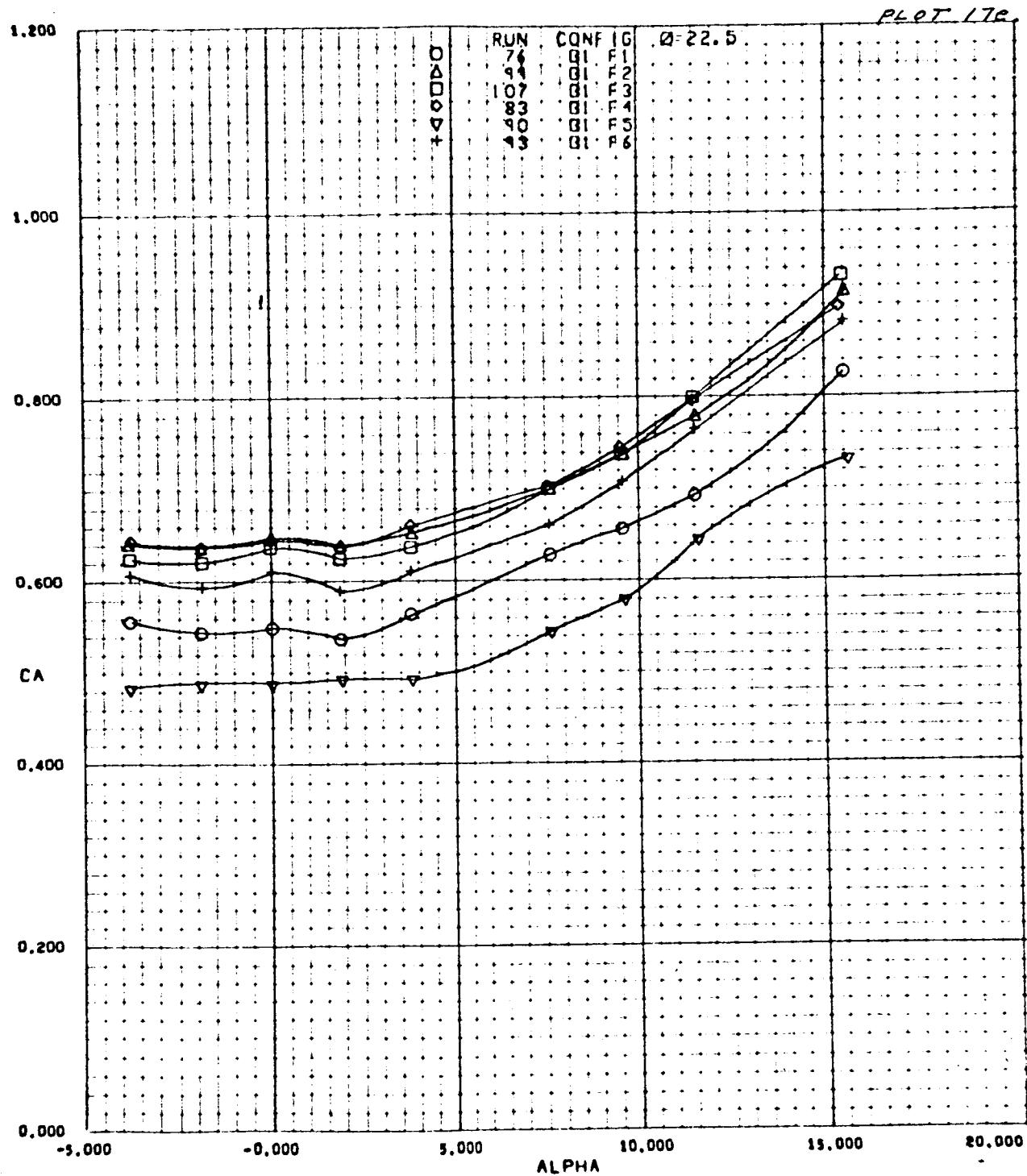


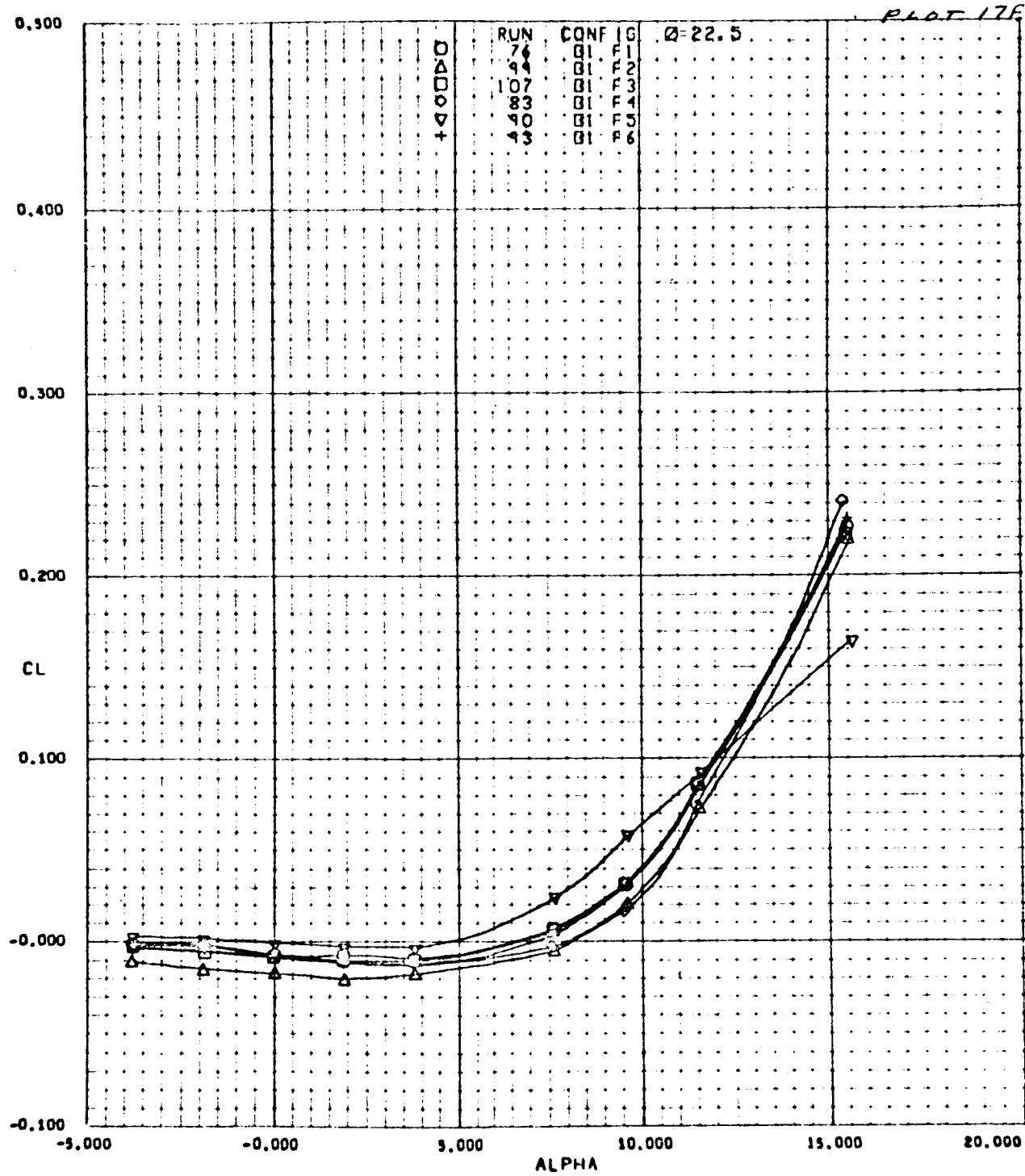


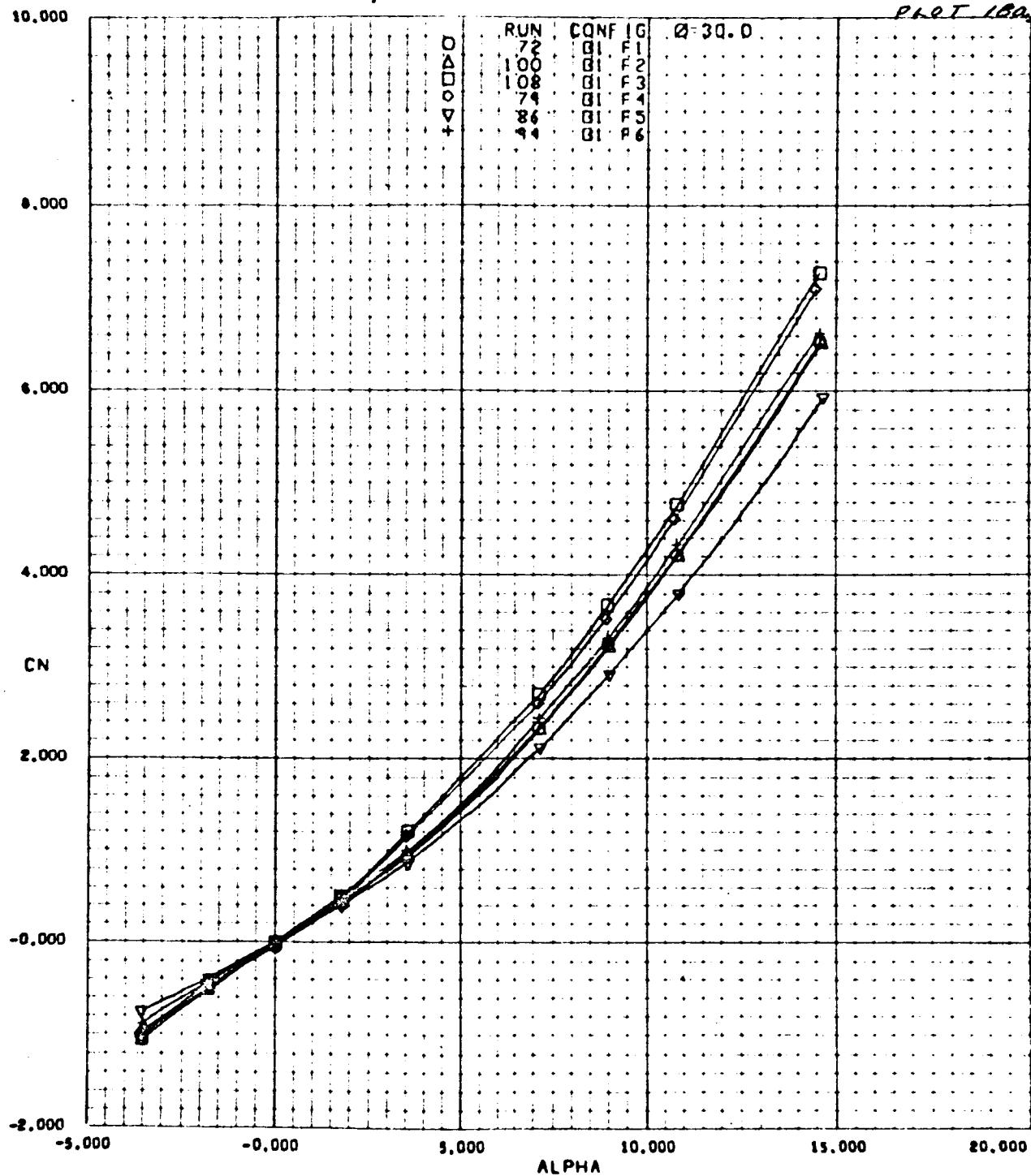


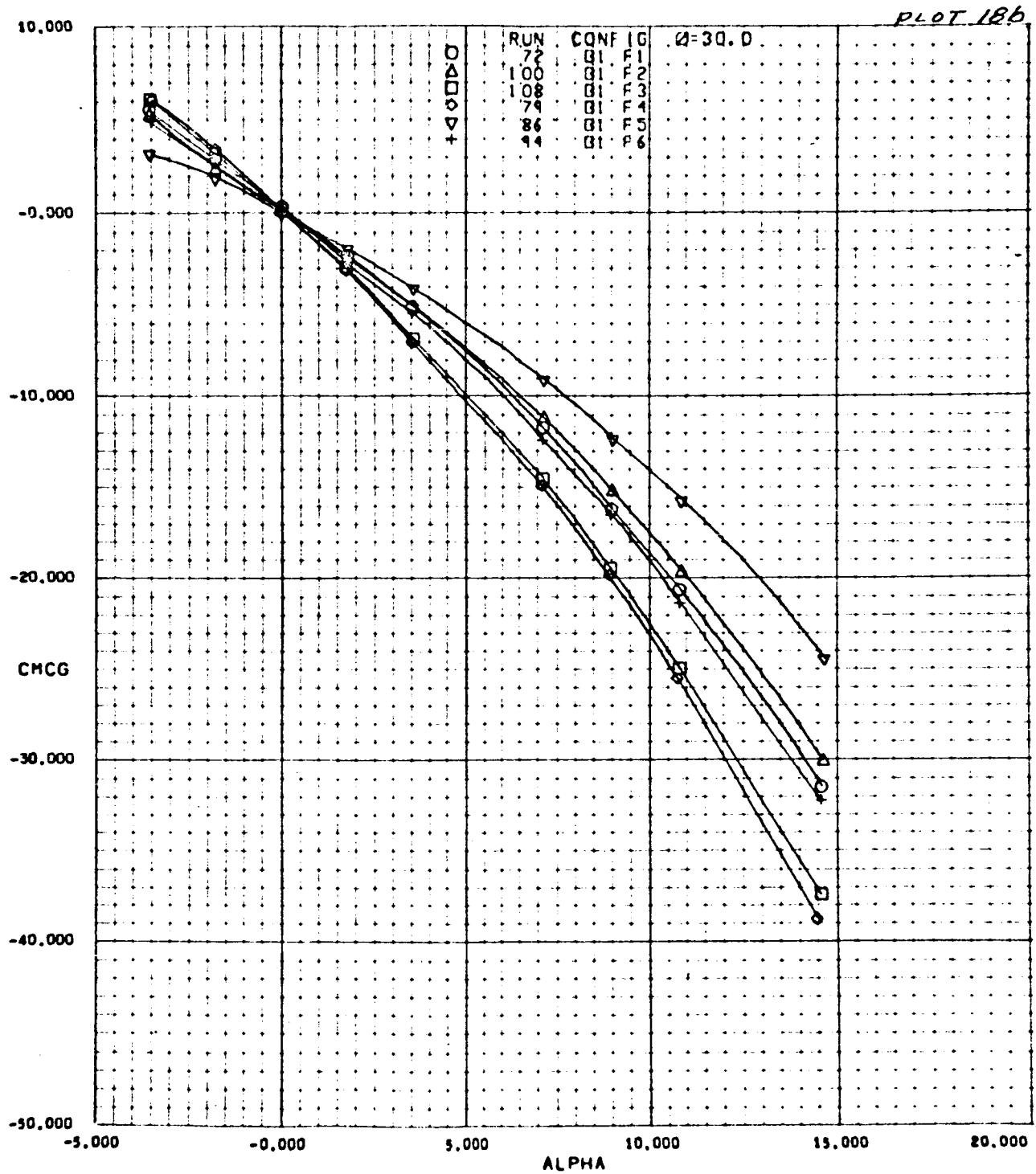


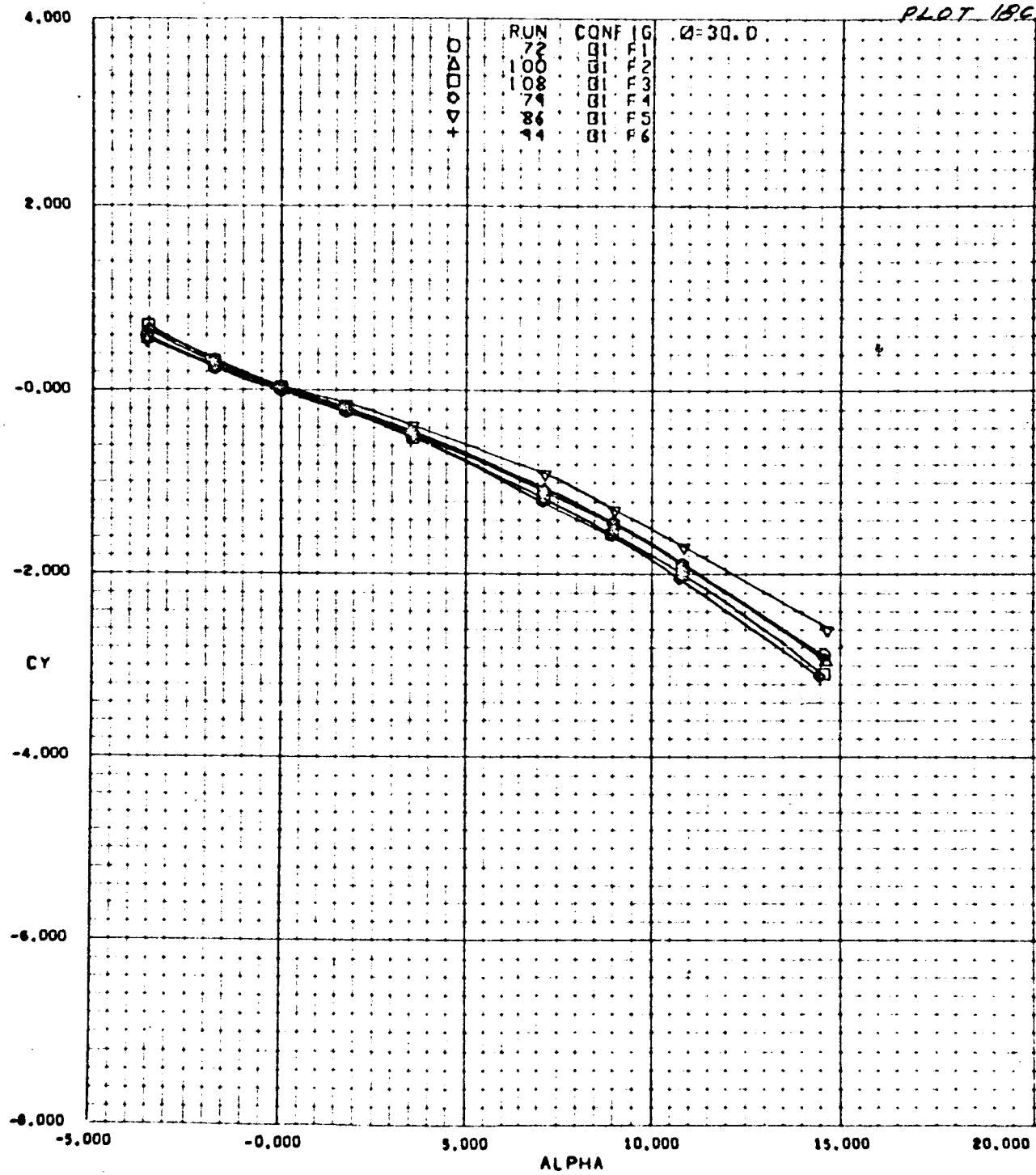


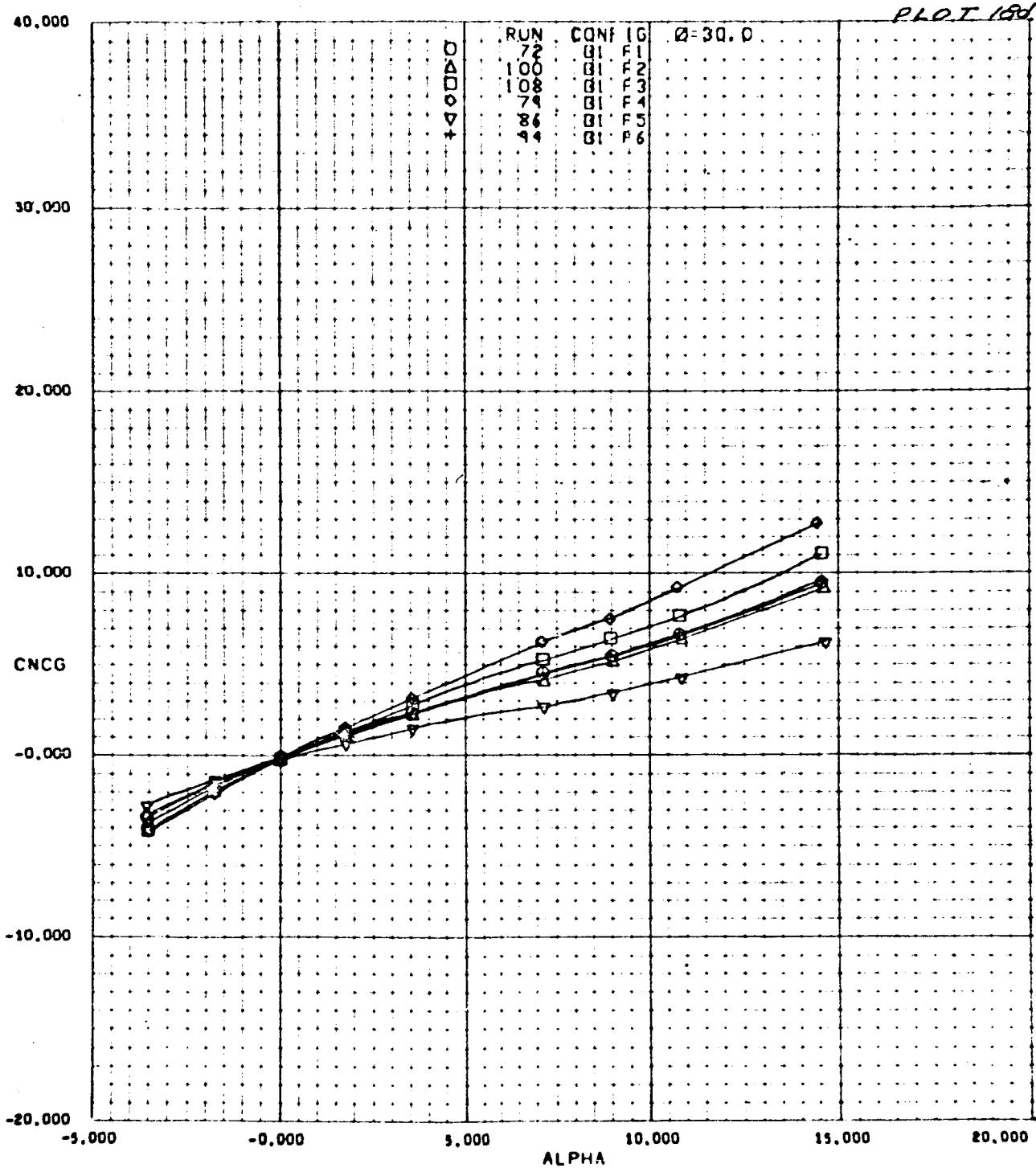


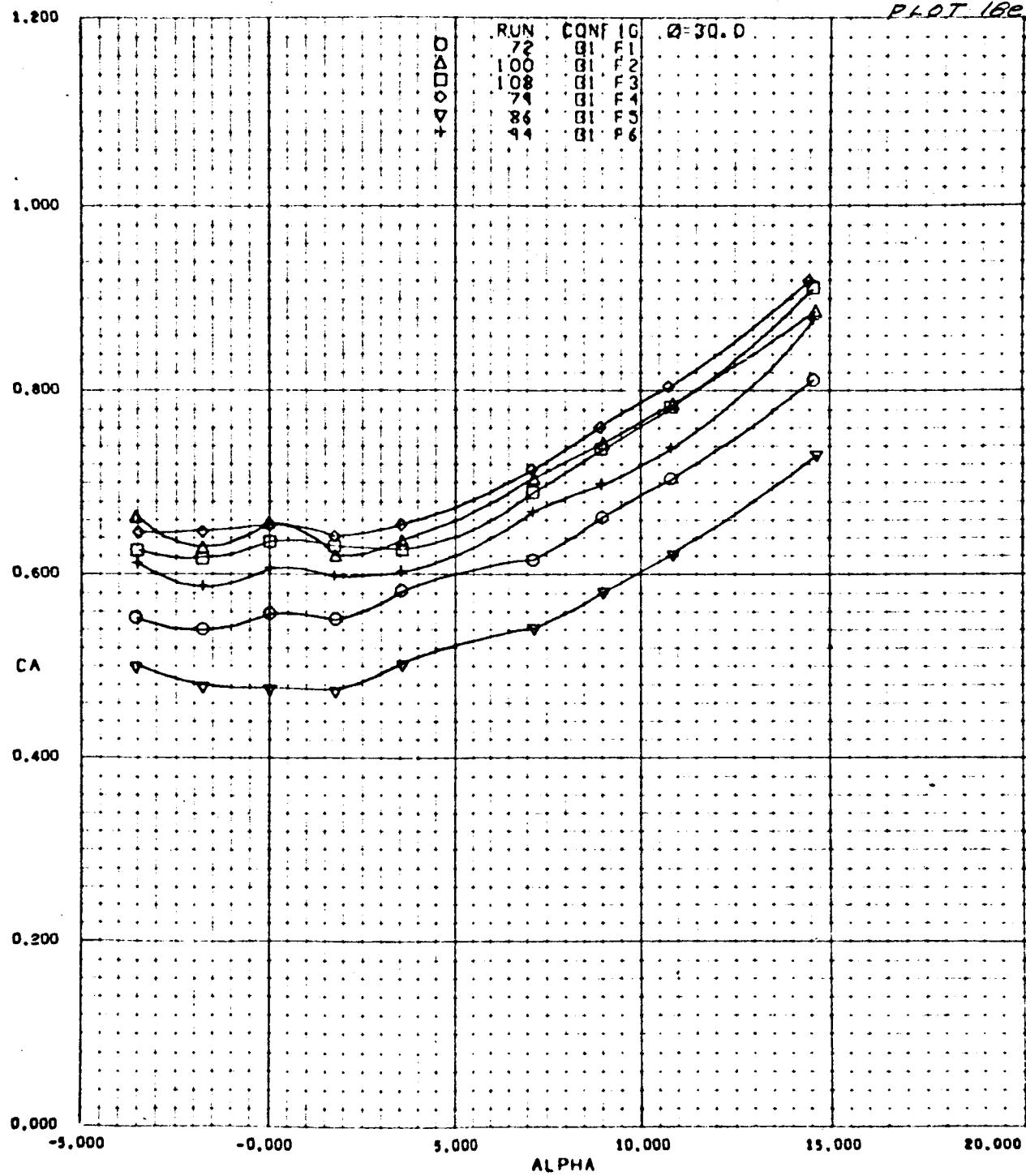


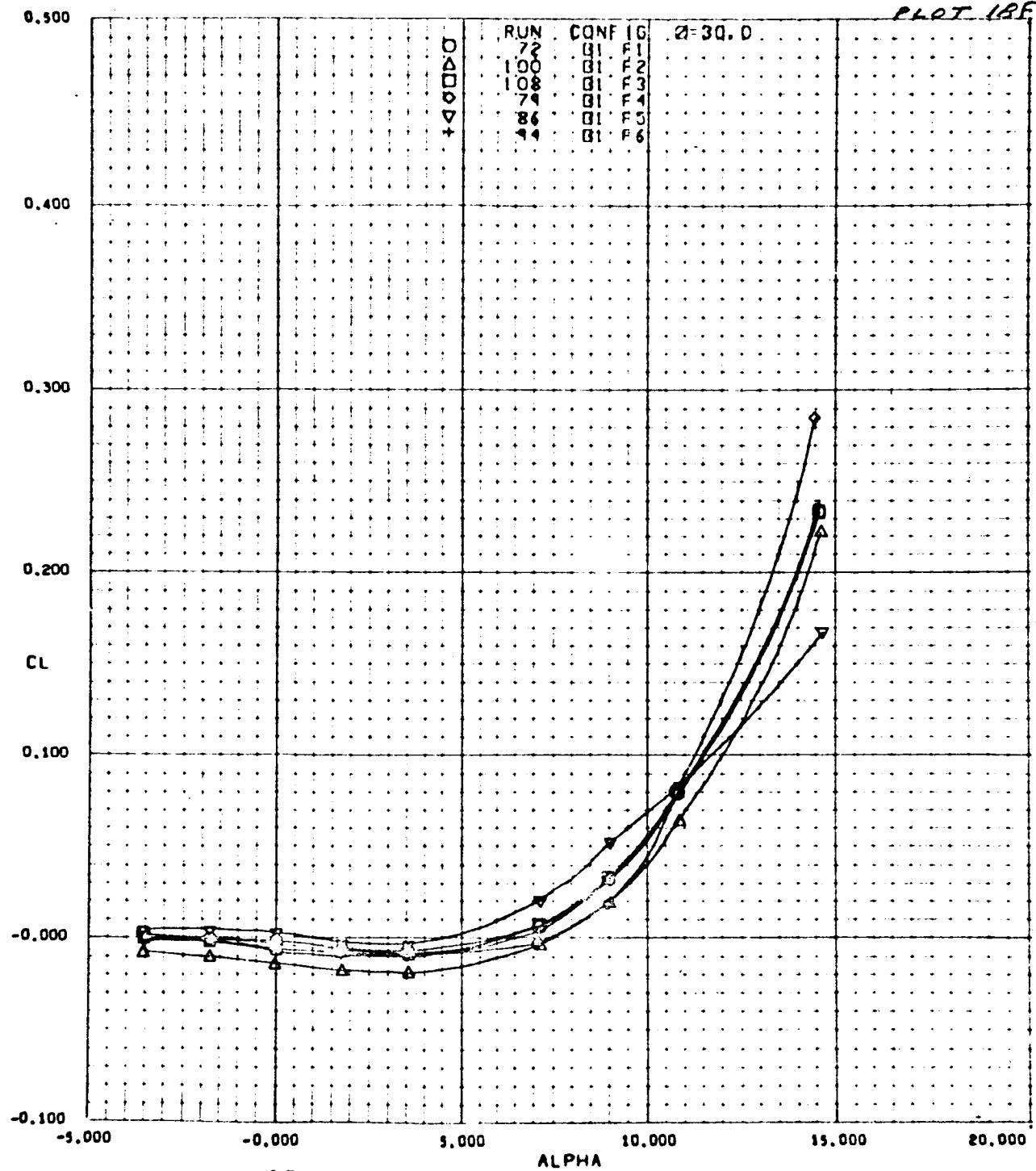


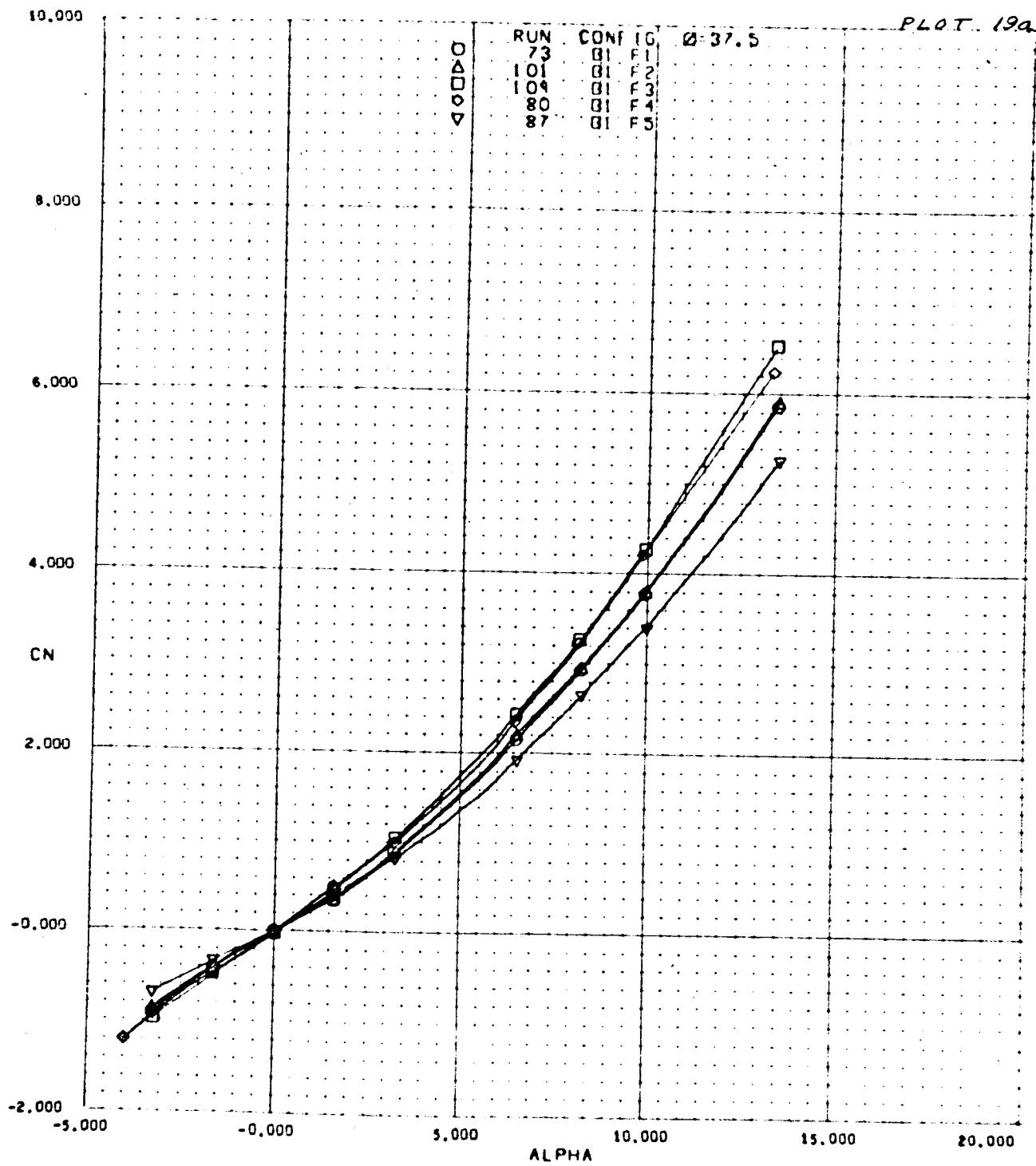


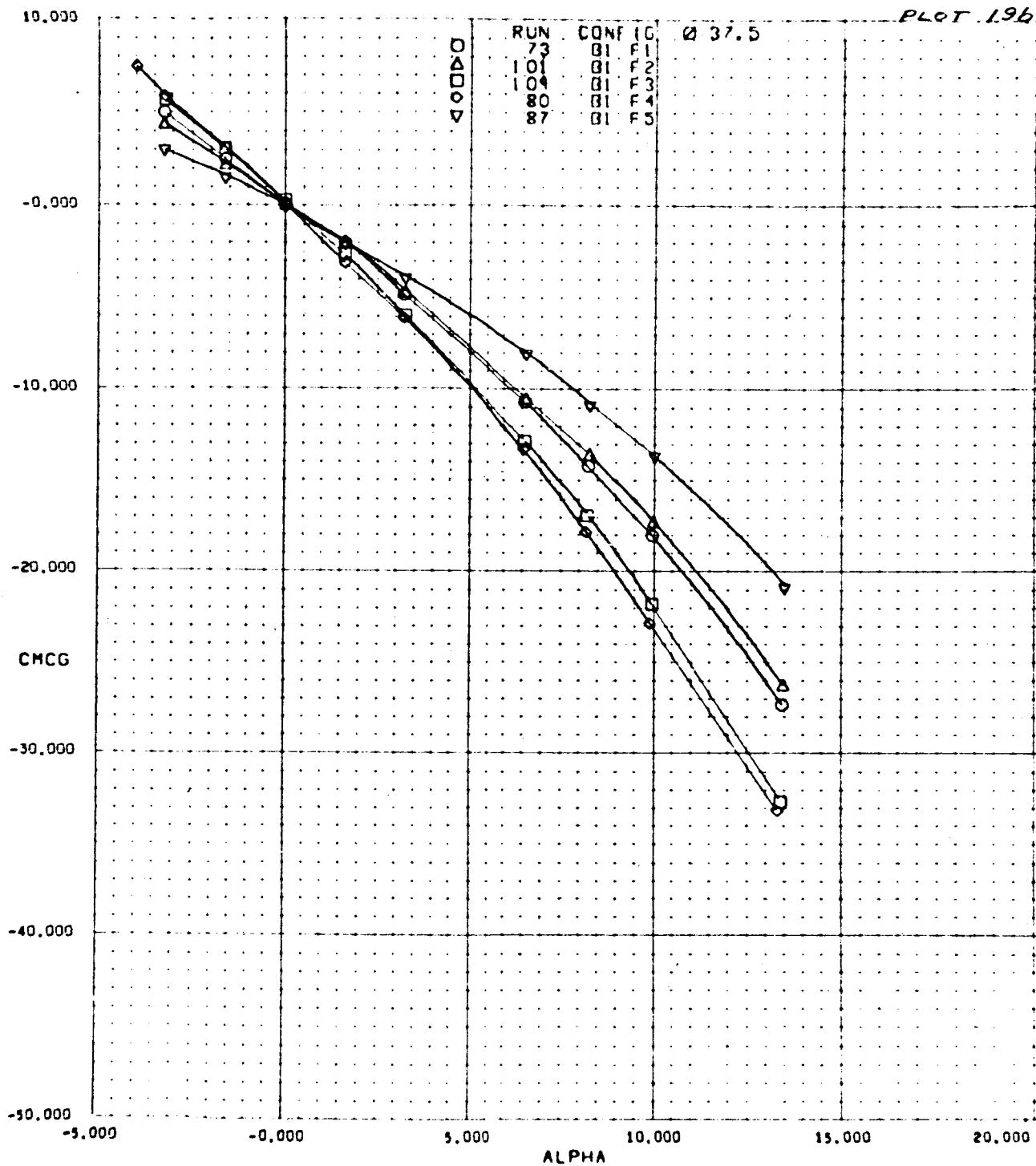












PLOT - 19c

